
The Taxonomy of the *Carex bicknellii* Group (Cyperaceae) and New Species for Central North America

Paul E. Rothrock

Randall Environmental Center, Taylor University, 236 W. Reade Avenue, Upland,
Indiana 46989-1001, U.S.A.

A. A. Reznicek

University of Michigan Herbarium, North University Building, Ann Arbor,
Michigan 48109-1057, U.S.A.

ABSTRACT. Based on morphology and karyology, we found the eastern North American species *Carex bicknellii* (sect. *Ovales*) to be a complex of four species. We describe two new species, *C. missouriensis* and *C. shimmersii*, and raise one variety, *C. bicknellii* var. *opaca*, to species rank as *C. opaca*. The three species segregated from *C. bicknellii* have lower chromosome numbers: $n = 23 \text{ II} + 1 \text{ III}$ to 27 II for *C. missouriensis*, $n = 29 \text{ II} + 1 \text{ III}$ to 30 II for *C. shimmersii*, and $n = 32 \text{ II} + 1 \text{ III}$ to 34 II for *C. opaca*. All three species are characterized by large tussocks, herbaceous textured foliage and smooth sheaths, and long apiculum on the achenes; they occupy hydric habitats. *Carex missouriensis*, a species characterized by awned pistillate scales, grows in remnant prairie swales from western Indiana to southeastern Nebraska. *Carex opaca*, with blunt scales and large perigynia, has a narrow distribution mostly limited to the periphery of the Ozark Mountain system. *Carex shimmersii*, with acuminate but unawned scales and perigynia smaller than *C. opaca* and *C. missouriensis*, ranges from northern Texas to southern Kansas. This last species is also contrasted with *C. brevior*, a species with similar morphology and overlapping range. *Carex bicknellii* in the strict sense is morphologically similar to the northeastern species *C. merritt-fernaldii*. They both have few culms per tussock, coriaceous foliage with papillose sheaths, papery, erose-margined perigynia, achenes with a very short apiculum, and relatively high chromosome numbers ($n = 35 \text{ II}$ to 39 II). These two species differ in characters of the anther, achene, and perigynium. They occupy more or less xeric habitats, especially in the Central Plains of the United States (*C. bicknellii*) and southern Canada eastward from the Great Lakes region (*C. merritt-fernaldii*).

Key words: *Carex*, Cyperaceae, North America.

In North America, *Carex* L. sect. *Ovales* Knuth

is a complex and diverse group of sedges with approximately 45 species occurring east of the Rocky Mountains. Recent studies of *Carex* biogeography (e.g., Hyatt, 1998) reveal that this section has still not received the attention necessary in the central United States, with some species proving much more common and extensive in range than previously understood. Even more importantly, taxonomic studies have brought to light new species of surprisingly common occurrence in the Ozark Mountain region and adjacent plains such as *C. ozarkana* P. Rothrock & Reznicek (1996a) and *C. molestiformis* Reznicek & P. Rothrock (1997).

Carex bicknellii Britton (sensu lato) is frequent in the prairie flora of the central United States (Mackenzie, 1931). As is typical for members of section *Ovales*, taxa within the *C. bicknellii* group have caespitose growth habit, gynecandrous spikes, more or less flattened, winged perigynia, and lenticular achenes with two stigmas.

The systematics of plants allied with *Carex bicknellii* has always been one of the most difficult problems within *Carex* sect. *Ovales*. Mackenzie (1931) provided the most recent monographic treatment of section *Ovales*, and he placed *C. bicknellii* in his large "subsection" *Festucaceae*. Members of the *Festucaceae* are characterized by sterile culms bearing erect or ascending leaves clustered at the shoot apex, perigynia with non-obovate bodies, and leaf sheaths having a strong white-hyaline zone on the ventral surface. In Mackenzie's treatment, *C. bicknellii* is placed close to *C. merritt-fernaldii* Mackenzie, *C. brittoniana* L. H. Bailey [= *C. tetrastachya* Scheele], and *C. hyalina* F. Boott. Since Mackenzie's monograph of the genus, Hermann (1972) described *C. bicknellii* var. *opaca* F. J. Hermann as a puzzling variation with affinities to *C. merritt-fernaldii* and *C. brittoniana*. This group has been informally designated the "*C. brevior* group"

by Reznicek and Rothrock (1997) and includes *C. brevior* (Dewey) Mackenzie, *C. molesta* Mackenzie ex Bright, *C. festucea* Willdenow, *C. molestiformis* Reznicek & P. E. Rothrock, as well as *C. merritt-fernaldii*, *C. bicknellii*, *C. bicknellii* var. *opaca*, and *C. tetrastachya*.

Variation in perigynium size in this group is especially striking, and is arrayed along a geographical spectrum. The widespread eastern species *C. festucea* and the very widespread more northern and transcontinental *C. brevior* have the smallest perigynia of the group ($2.3\text{--}5 \times 1.5\text{--}3.5$ mm), whereas the southwestern-most species, *C. tetrastachya*, has the largest ($5.5\text{--}8(-8.7) \times (3.5\text{--})4\text{--}6.1$ mm). Lying between these two extremes, both geographically and in perigynium size, are plants referred to as *C. bicknellii*. In most keys, *C. bicknellii* is sharply delimited by its large perigynia that are strongly nerved over the achene on the adaxial surface.

As understood at the beginning of our investigation, *Carex bicknellii* consisted of two varieties. The typical variety has translucent copper-tinged perigynia and few culms per clump. It occurs not only in dry to mesic prairie of the central United States, but also has populations scattered eastward to Pennsylvania and New England. The rarer *C. bicknellii* var. *opaca*, as its name implies, has less translucent (but still thin and papery) perigynia that lack any copper coloration. Although found in historically prairie habitat, this taxon, compared to typical *C. bicknellii*, occupies more hydric sites and has a narrower geographic range that includes Arkansas, parts of Missouri, and eastern Kansas.

Our initial research questions focused upon sharpening our understanding of the taxonomy and biogeography of *Carex bicknellii* var. *opaca* and upon how, morphologically and ecologically, to differentiate *C. bicknellii* from *C. merritt-fernaldii*. It soon became apparent from our field investigation and chromosome studies that the species limits and probable relationships for *C. bicknellii* were poorly understood. *Carex bicknellii* (sensu stricto) should be recognized as an entity distinct at the species level from *C. bicknellii* var. *opaca* based on morphological and karyological criteria. In turn, the latter proved to be a complex of three species: *C. opaca*, *C. missouriensis*, and *C. shinnensis*, the last two described later in this paper. Once these additional species elements are clarified, *C. bicknellii* (sensu stricto) and *C. merritt-fernaldii* form a coherent group with only a more distant phylogenetic relationship to *C. opaca* and its related species.

MATERIALS AND METHODS

This study was based upon available materials from the following herbaria: APCR, BH, BRIT, BUT, Hb. C. T. Bryson (personal herbarium of Charles T. Bryson, Stoneville, Mississippi), DAO, DUKE, F, GA, GH, ILLS, IND, ISC, KANU, KSC, MICH, MO, MOR, MT, NCU, NDA, NEB, NHA, NY, OKL, OMA, OS, PUL, SIU, TRTE, UNB, US, WIN, and WIS. Approximately 3000 sheets were studied.

Morphological variation within the *Carex bicknellii* complex was assessed by analysis of herbarium specimens selected from the geographic, habitat, and morphologic ranges of these taxa. After a broad survey of all the morphological and micro-morphological characters that appeared to vary among these species, we quickly focused on qualitative and quantitative features of the achenes, perigynia, pistillate scales, inflorescences, and sheaths as offering the best discriminating potential. In addition to the herbarium material examined, we undertook extensive fieldwork for chromosome and morphological studies in an area extending from western Indiana to southern Iowa and southward to northern Texas. Less extensive field studies were carried out in New England and the Great Lakes region. A total of about 70 populations were examined in the field.

Numerical analyses, including univariate statistics and scatter plots, focused upon characters of the perigynium, pistillate scale, and achene. With the exception of papillose versus non-papillose epidermal surface, diagnostic vegetative characters could not be found. Principal component analysis (PCA) aided in exploring differences between *C. missouriensis*, *C. opaca*, and *C. shinnensis*. The PCA was based upon a sample of 110 specimens and 16 quantitative traits. A somewhat smaller sample size for *C. shinnensis* ($N = 33$) reflects the rarity of this taxon. From standardized data, NTSYS-pc (version 2.0, Rohlf, 1997) was used to obtain a correlation matrix, extract Eigenvectors, and plot OTUs.

Chromosome analyses followed the technique of Cooperrider and Morrison (1967) as detailed in Rothrock and Reznicek (1996b). Briefly, overwintered plants were stimulated to flower under greenhouse conditions. Immature spikes were collected and preserved in methanol, chloroform, and propionic acid (6:3:2). Anthers were dissected from the spikes and squashed in 2% lactic-acetic-orcein and viewed using phase contrast at $1000\times$ magnification. Meiosis I chromosome figures were examined from five or more pollen mother cells. Drawings, photographs, and voucher herbarium specimens

Table 1. Chromosome counts for members of the *Carex bicknellii* group. Vouchers cited are deposited in MICH, with photographs. AAR = A. A. Reznicek, PER = P. E. Rothrock.

Species	<i>n</i>	Source
<i>Carex bicknellii</i> Britton	38 II	Löve & Löve (1981)
	38 II	IL, Macoupin Co., PER 3547a
	38 II	IL, Macoupin Co., PER 3547b
	38 II	MO, Callaway Co., PER 3554
	39 II	MO, Audrain Co., PER 3549
<i>Carex merritt-fernaldii</i> Mackenzie	35 II	Tanaka (1942)
	37 II	Tanaka (1942)
	37 II	Rothrock & Reznicek (1998)
	37 II	OH, Lucas Co., PER 3732
<i>Carex opaca</i> P. Rothrock & Reznicek	32 II +1 III	AR, Lonoke Co., PER 2886
	32 II +1 III	MO, Stoddard Co., PER 3551c
	33 II	Rothrock & Reznicek (1996b)
	33 II	OK, Ottawa Co., AAR 9761
	34 II	MO, Stoddard Co., PER 3551a
	34 II	MO, Stoddard Co., PER 3551b
<i>Carex shimmersii</i> P. Rothrock & Reznicek	29 II +1 III	TX, Delta Co., AAR 10367b
	30 II	TX, Delta Co., AAR 10367a, c
	30 II	TX, Kaufman Co., AAR 10347
<i>Carex missouriensis</i> P. Rothrock & Reznicek	23 II +1 III	MO, Macon Co., PER 3567
	24 II +1 III	IL, Fayette Co., PER 3539a
	24 II +1 III	IL, Fayette Co., PER 3539b
	24 II +1 III	MO, Chariton Co., PER 3560
	24 II +2 III	IL, Clinton Co., PER 3569
	25 II	MO, Audrain Co., PER 3550
	25 II +1 III	MO, Macon Co., AAR 9856
	26 II	MO, Callaway Co., PER 3553
	26 II	MO, Schuyler Co., PER 3557
	27 II	IL, Macoupin Co., PER 3546

cited in Table 1 have been deposited at the University of Michigan Herbarium (MICH).

RESULTS

Carex bicknellii and *C. merritt-fernaldii* share habitat, vegetative, reproductive, and karyotypic characters that separate them sharply from *C. opaca*, *C. missouriensis*, and *C. shimmersii*. *Carex bicknellii* and *C. merritt-fernaldii* occupy drier habitats (upland prairies; dry open, sandy woodlands and savannas; sandy or gravelly, dry successional habitats; and thin, dry soil over rock) and, under both field and greenhouse conditions, have fewer shoots per tussock. The leaf sheaths of these two species, except on the ventral hyaline band, bear fine papillae visible at 30× magnification (Fig. 1). The contrasting species (*C. missouriensis*, *C. opaca*, and *C. shimmersii*), found in wet prairies, ditches, and open bottomlands, often in clay or muck soils, not only may produce many culms per tussock but have sheaths that are consistently devoid of papillae.

Reproductive characters also indicate a close affinity between *C. bicknellii* and *C. merritt-fernaldii*.

The perigynium wall of these two species is thin-textured or even more or less translucent and tends to form an erose, scalloped, or even irregularly toothed margin at the shoulder. This is in contrast to the thicker-textured, opaque perigynium wall with uniformly fine-serrulate, usually symmetrically tapered margins typical of species in section *Ovales* as a whole. Furthermore, the achenes of *C. bicknellii* and *C. merritt-fernaldii* contrast with those of *C. opaca*, *C. missouriensis*, and *C. shimmersii*. The latter group of species bears a prominent apiculum, 0.4–1.2 mm long (mean = 0.74 ± 0.02, N = 108), but apicula of *C. bicknellii* and *C. merritt-fernaldii* seldom reach 0.5 mm (mean = 0.28 ± 0.01, N = 63) (Figs. 2, 3).

Finally, karyological investigation supports the close affinity of *Carex bicknellii* and *C. merritt-fernaldii* (Table 1). We found a haploid number of *n* = 38 II or 39 II (5 counts) for *C. bicknellii*. Chromosome counts for *C. merritt-fernaldii* range from 35 II as reported by Tanaka (1942) to 37 II (Rothrock & Reznicek, 1998) (4 counts). These contrast markedly to the very low chromosome counts ob-

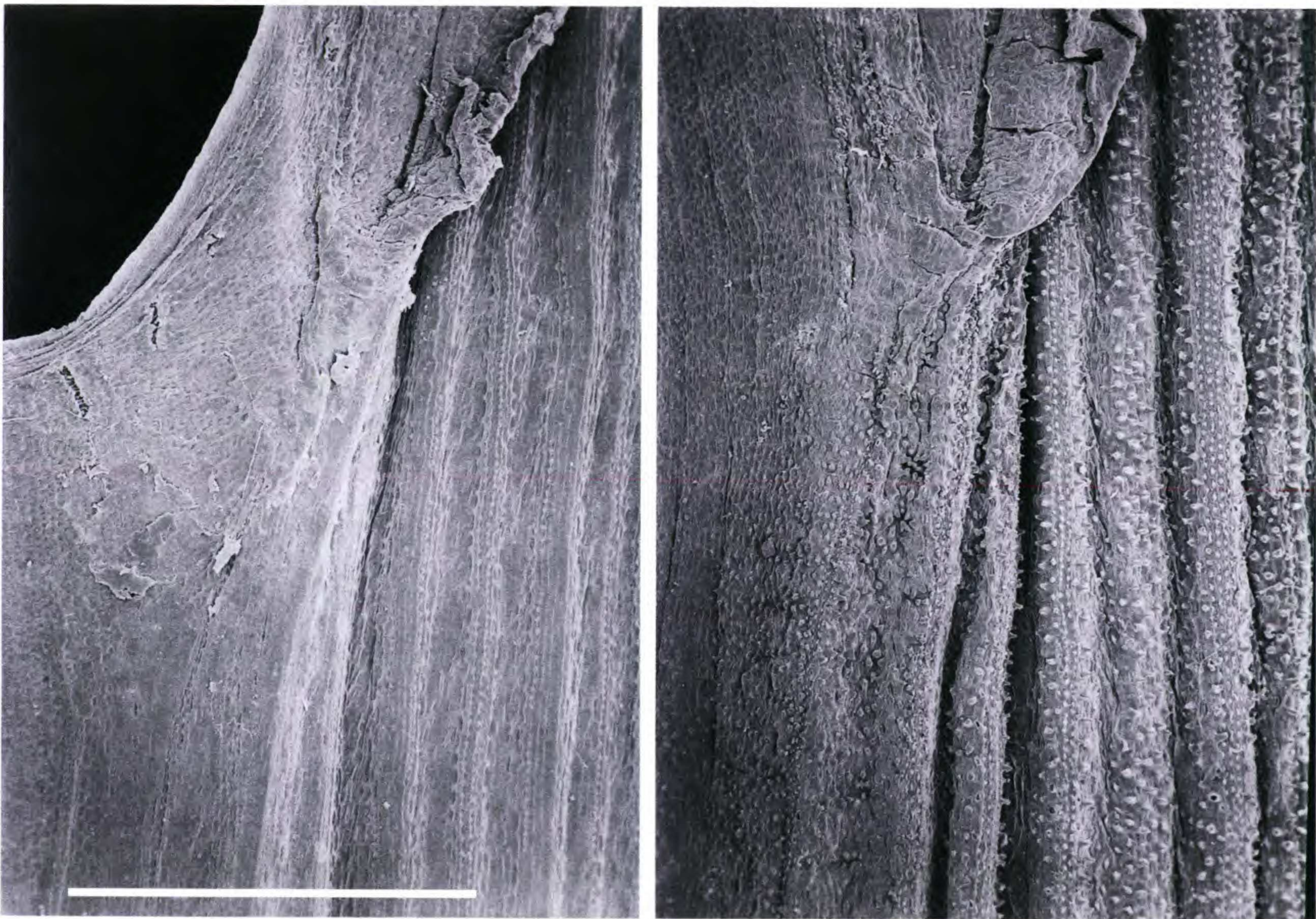


Figure 1. Scanning electron micrograph of leaf sheaths: *Carex bicknellii* (right) and *C. missouriensis* (left). Scale bar = 1 mm for both species.

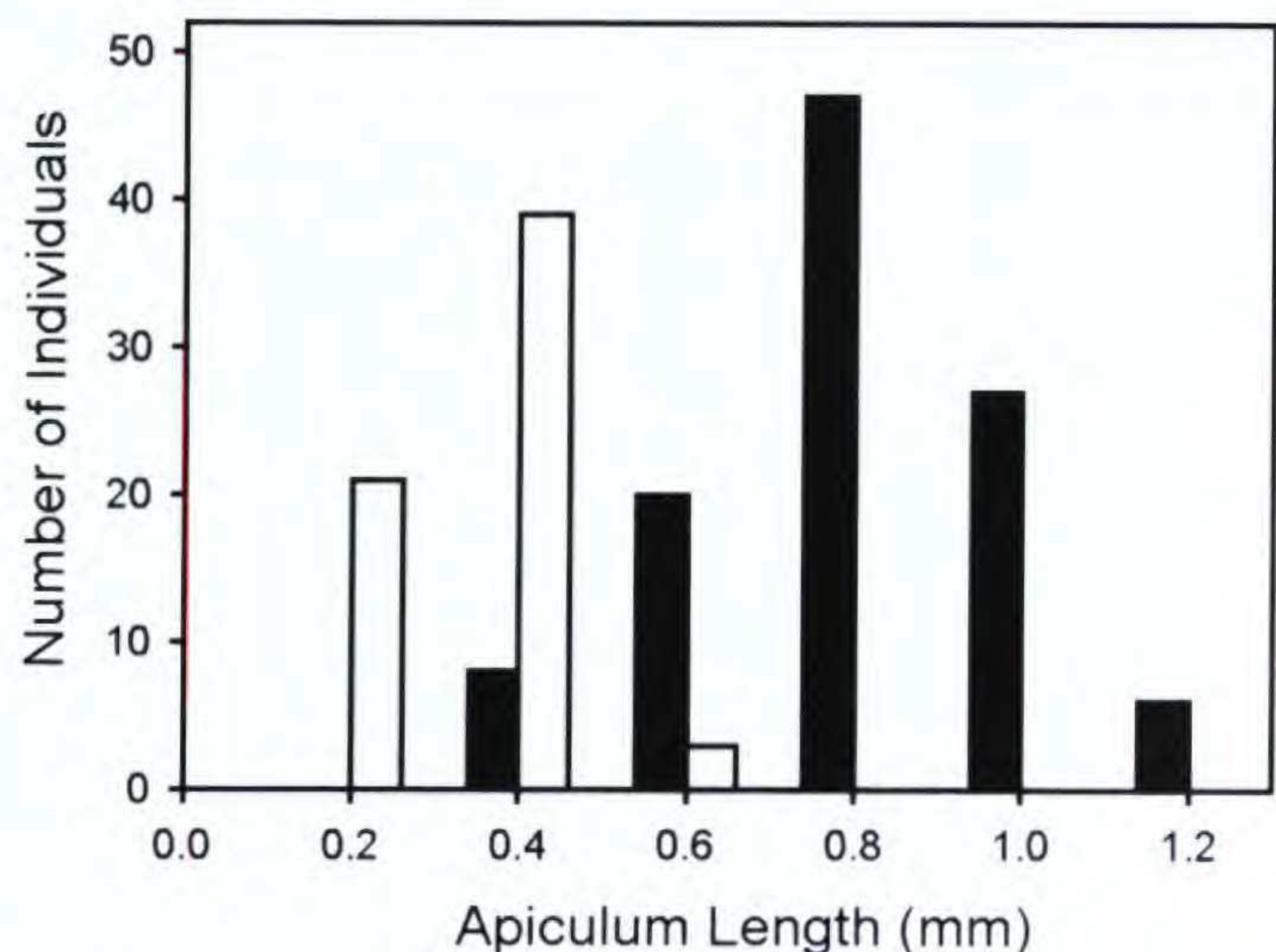


Figure 2. Apiculum length of *Carex bicknellii* and *C. merritt-fernaldii* (open bars) versus that of *C. missouriensis*, *C. opaca*, and *C. shinniersii* (solid bars).

served for *C. missouriensis* ($n = 23$ II + 1 III to 27 II; 10 counts) and slightly higher counts for *C. opaca* ($n = 32$ II + 1 III to 34 II; 6 counts) and *C. shinniersii* ($n = 29$ II + 1 III and 30 II; 3 counts) (Table 1).

Carex merritt-fernaldii has sometimes been submerged into a broadly conceived *C. brevior*, but still with the recognition of *C. bicknellii* (Gleason, 1952;

Gleason & Cronquist, 1991). This represents a misunderstanding of the relationships within this group. *Carex brevior* differs in numerous vegetative, reproductive, and karyotypic features from *C. merritt-fernaldii*, and they are certainly not each other's closest relatives. In fact, many of the features by which *C. missouriensis*, *C. opaca*, and *C. shinniersii* differ from *C. bicknellii* and *C. merritt-fernaldii* are also the features by which *C. brevior* differs from *C. bicknellii* and *C. merritt-fernaldii*, including lower chromosome number (Rothrock & Reznicek, 1998), smooth sheaths, uniformly fine-serrulate, symmetrically tapered perigynium margins, and thicker-textured, opaque perigynia. It seems quite likely that a phylogenetic study of section *Ovales* would show that *C. missouriensis*, *C. opaca*, and *C. shinniersii* are more closely related to *C. brevior* and its close allies than to *C. bicknellii* and *C. merritt-fernaldii*. We use the term *Carex bicknellii* group only because all three of these species previously have been considered part of *C. bicknellii*.

TAXONOMY OF *CAREX MISSOURIENSIS*, *C. OPACA*, AND *C. SHINNERSII*

Initially, our realization that *Carex opaca* included additional taxa grew out of an investigation of

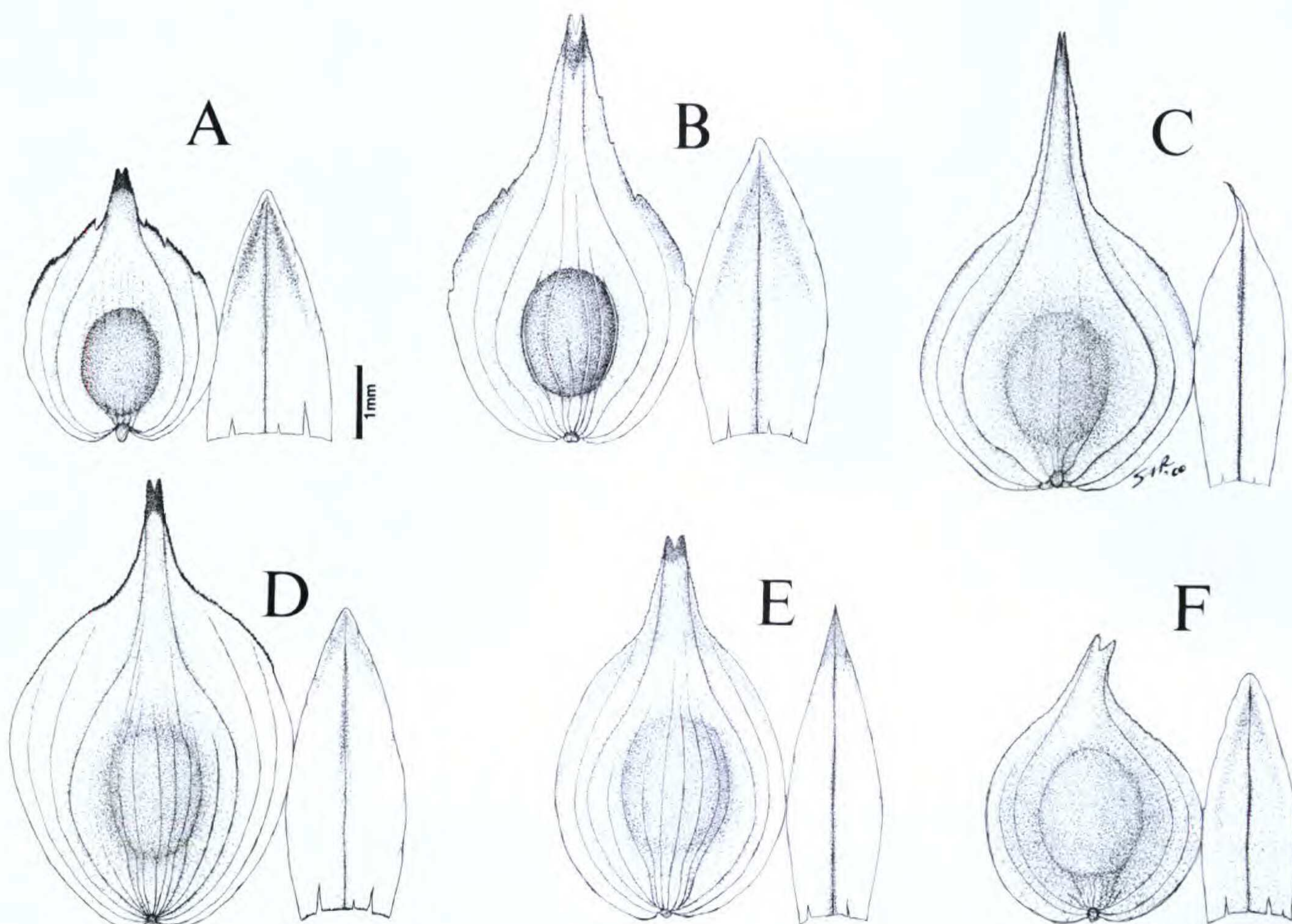


Figure 3. Perigynia and pistillate scales of: —A. *Carex merritt-fernaldii* (from Reznicek 10067), —B. *C. bicknellii* (from Reznicek 10203), —C. *C. missouriensis* (from Reznicek 9859), —D. *C. opaca* (from Sheperd 340), —E. *C. shinniersii* (from Morse 3450), and —F. *C. brevior* (from Morse 3451). Vouchers at MICH.

Table 2. *Carex missouriensis*, *C. opaca*, and *C. shinnersii* Eigenvector weightings in Axis 1 and Axis 2 for 16 characters of pistillate scale, perigynium, and achene. Variation in Axis 1 = 34.0%; variation in Axis 2 = 15.7%.

Character	Axis 1	Axis 2
Pistillate scale length (mm)	0.208	0.424
Pistillate scale width (mm)	0.613	−0.005
Pistillate scale length:width ratio	−0.502	0.301
Perigynium length (mm)	0.877	−0.092
Perigynium width (mm)	0.784	0.201
Perigynium body length (mm)	0.898	0.089
Distance from base to widest point of perigynium (mm)	0.536	0.478
Distance to widest point:body length ratio	−0.536	0.487
Beak length (mm)	0.230	−0.378
Achene summit to beak apex (mm)	0.692	−0.510
Beak length:distance to beak apex ratio	−0.632	0.228
Number of adaxial nerves	0.427	0.567
Achene length (mm)	0.126	0.633
Achene width (mm)	0.482	0.662
Achene length:width ratio	−0.381	−0.152
Apiculum length (mm)	0.705	−0.279

meiotic karyotypes. A population from Macon County, Missouri, from prairie swale habitat, was found to possess a strikingly low number of chromosomes. Further analysis of *C. missouriensis* confirmed that this condition was consistent (Table 1) and could be associated with readily observable macroscopic traits. In contrast to *C. opaca* (with haploid chromosome numbers of $n = 32 \text{ II} + 1 \text{ III}$, 33 II , 34 II), *C. missouriensis* chromosome numbers range from $n = 23 \text{ II} + 1 \text{ III}$ to 27 II (Table 1).

During the morphometric analysis of inflorescence, perigynium, and achene characters of *Carex opaca* and *C. missouriensis*, a third taxon became evident. This species, *C. shinnersii*, includes populations from Texas originally reported by Jones and Reznicek (1991) as *C. bicknellii* var. *bicknellii*. With $n = 29 \text{ II} + 1 \text{ III}$ or 30 II chromosomes, the karyotype of *C. shinnersii* is intermediate in number between *C. opaca* and *C. missouriensis* (Table 1).

Although karyologically distinctive, the morphological differences between these species can be subtle. We have not discovered vegetative characters that are diagnostic among the three species. Instead, the potential diagnostic characters are limited to the spikes, especially qualitative traits of the pistillate and staminate scales. Of the three species, *Carex opaca* has scale apices that are obtuse to acute (Fig. 3), similar to most species within section *Ovales*. Pistillate scales of *C. missouriensis*, on the other hand, are clearly awn-tipped (up to 0.7 mm long), with the awns often somewhat curly and often slightly recurved. The awns and recurved tendency are most evident at the pre-flowering stage of spike development when the spike takes on a decidedly

echinate appearance. The awns in *C. missouriensis* are quite distinctive in being whitish-hyaline tissue that appears to be an extension of the relatively broad hyaline scale margins and lacks a midvein. Several apparently unrelated species within section *Ovales* also have awn-tipped scales (e.g., *C. alata* Torrey, *C. hormathodes* Fernald, and *C. straminea* Willdenow). None of these species possesses the slight recurvation or echinate immature spikes, and the awns appear to be the excurrent midveins of the scales. The presence of the awn tip in these species likely represents a homoplasy. The scale apex in *C. shinnersii*, the third member of this complex, is acuminate and occasionally appears to be awned (Fig. 3). However, unlike *C. missouriensis*, the tip is firm and colored because it is formed by the excurrent midvein extending beyond the herbaceous scale tip.

The PCA of 16 quantitative traits of the pistillate scale, perigynium, and achene (Table 2) documented the fine differences between these species. *Carex opaca* forms a cluster that is high on both axis 1 and axis 2. However, it has some degree of overlap with *C. missouriensis* and *C. shinnersii*. The Eigenvector values (Table 2) suggest that the position of *C. opaca* primarily is due to its somewhat larger perigynia (particularly overall length, width, and body length). *Carex missouriensis* clustered low on axis 2. The Eigenvector values, in this case, suggest that *C. missouriensis* has smaller achenes and a more elongated beak area (as measured by the distance from the achene summit to beak apex). *Carex shinnersii*, which occupies the quadrate low on axis 1 and high in axis 2 (Fig. 4), has the small-

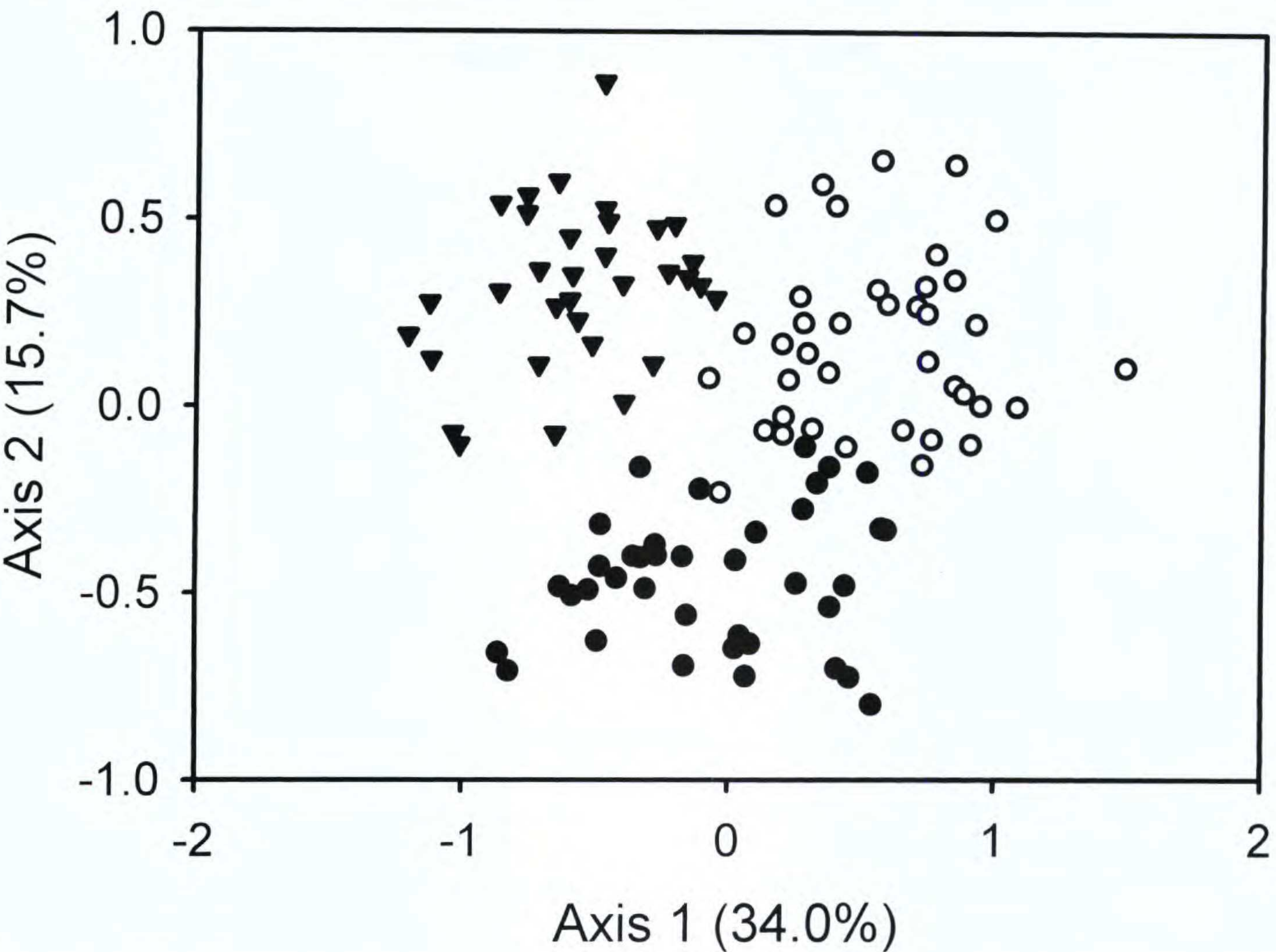


Figure 4. PCA of *Carex missouriensis* (dots), *C. opaca* (circles), and *C. shinnersii* (inverted triangles) showing axis 1 and axis 2.

est perigynia. For example, perigynium length averages 5.2 ± 0.1 (N = 33) compared to 5.7 ± 0.1 (N = 39) and 6 ± 0.1 (N = 38) for *C. missouriensis* and *C. opaca*. Much of the differential between *C. shinnersii* and *C. missouriensis* perigynia is localized in the upper body and beak. The achene summit to beak apex distance for *C. shinnersii* seldom reaches 3 mm, but the same length measure in *C. missouriensis* is mostly 3–3.8 mm.

The apices of pistillate and staminate scales are diagnostic among the three species, and we therefore carefully explored other possible quantitative differences in the pistillate scales. PCA provided only moderate Eigenvector values for overall width and length to width ratio of pistillate scales (Table 2) and small values for overall length. However, differences in these characters exist among the species. Pistillate scales of *Carex shinnersii* are narrower (1.32 ± 0.13 mm; N = 33) compared to those of *C. opaca* (1.53 ± 0.18 mm; N = 38). The average pistillate scale length to width ratio of *C. shinnersii* is 3.26 ± 0.38 in contrast to 2.86 ± 0.23 (N = 39) for *C. missouriensis* and 2.76 ± 0.27 for *C. opaca*. Unfortunately, due to strongly overlap-

ping ranges, these differences, although meaningful, are difficult to apply to individual plants.

Aside from members of the *Carex opaca* complex, the sedge species most difficult to distinguish from *C. shinnersii* is *C. brevior*. *Carex brevior*, as we currently understand this species, has broad morphological as well as karyotypic variation. Plants from populations in Texas, Oklahoma, Wisconsin, and Manitoba can be remarkably robust. We evaluated the variation of pistillate scale, perigynia, and achenes in a sample of *C. brevior* that included available robust specimens as well as “typical” *C. brevior*. In evaluating the pistillate scale, we attempted a careful quantification of the amount of pointedness to the pistillate scale. This value is the distance from the scale apex to where scale width reaches 0.5 mm. Although a very few exceptional *C. brevior* individuals had perigynia barely over 5 mm in length, they could, with few exceptions, be separated from *C. shinnersii* when combined with pistillate scale length (Fig. 5). Even sharper differences between taxa were achieved by contrasting perigynium length with scale pointedness (Fig. 6). The latter feature, though quite difficult to measure,

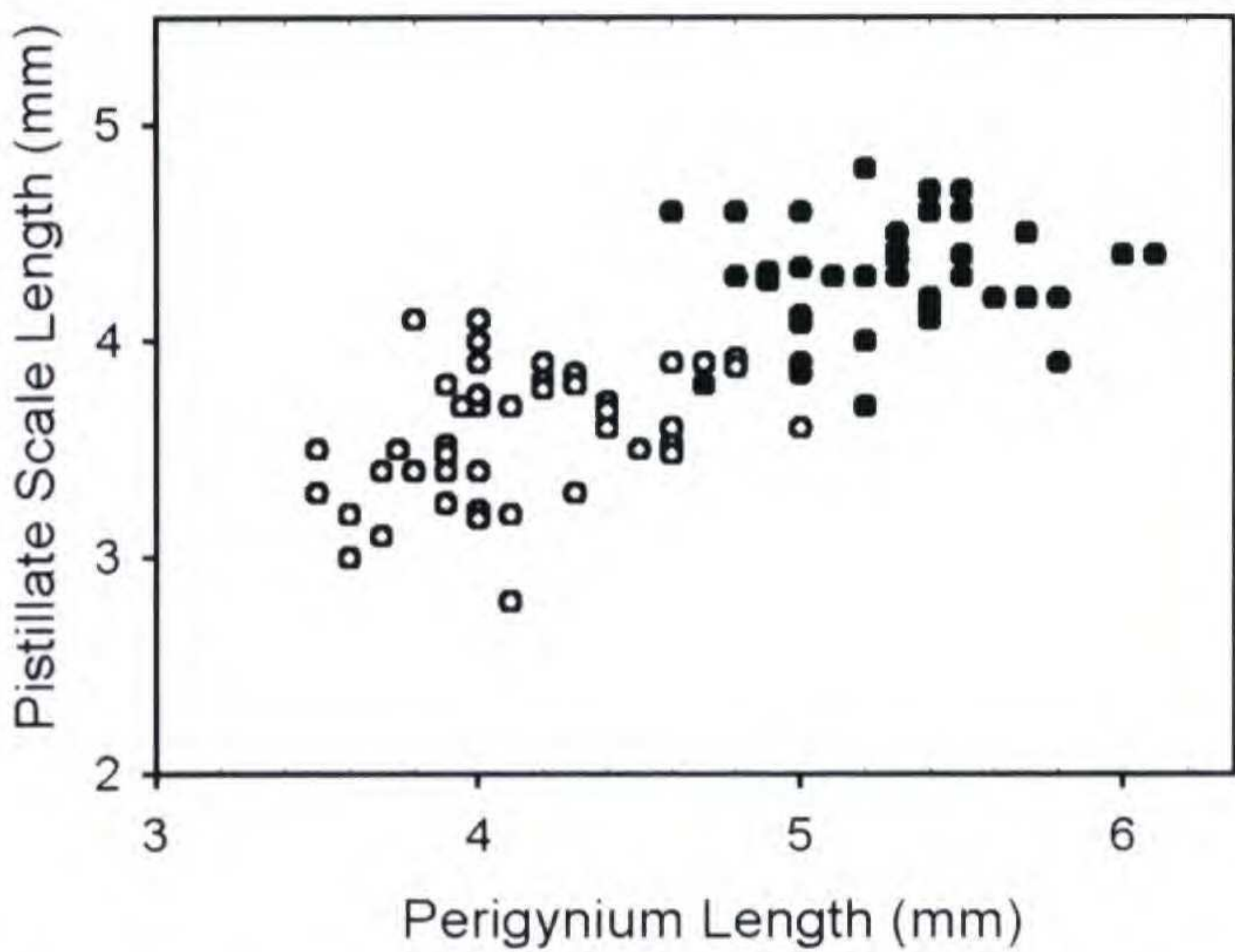


Figure 5. Scatter plot of perigynium length and pistillate scale length of *Carex brevior* (circles) and *C. shinnensis* (dots).

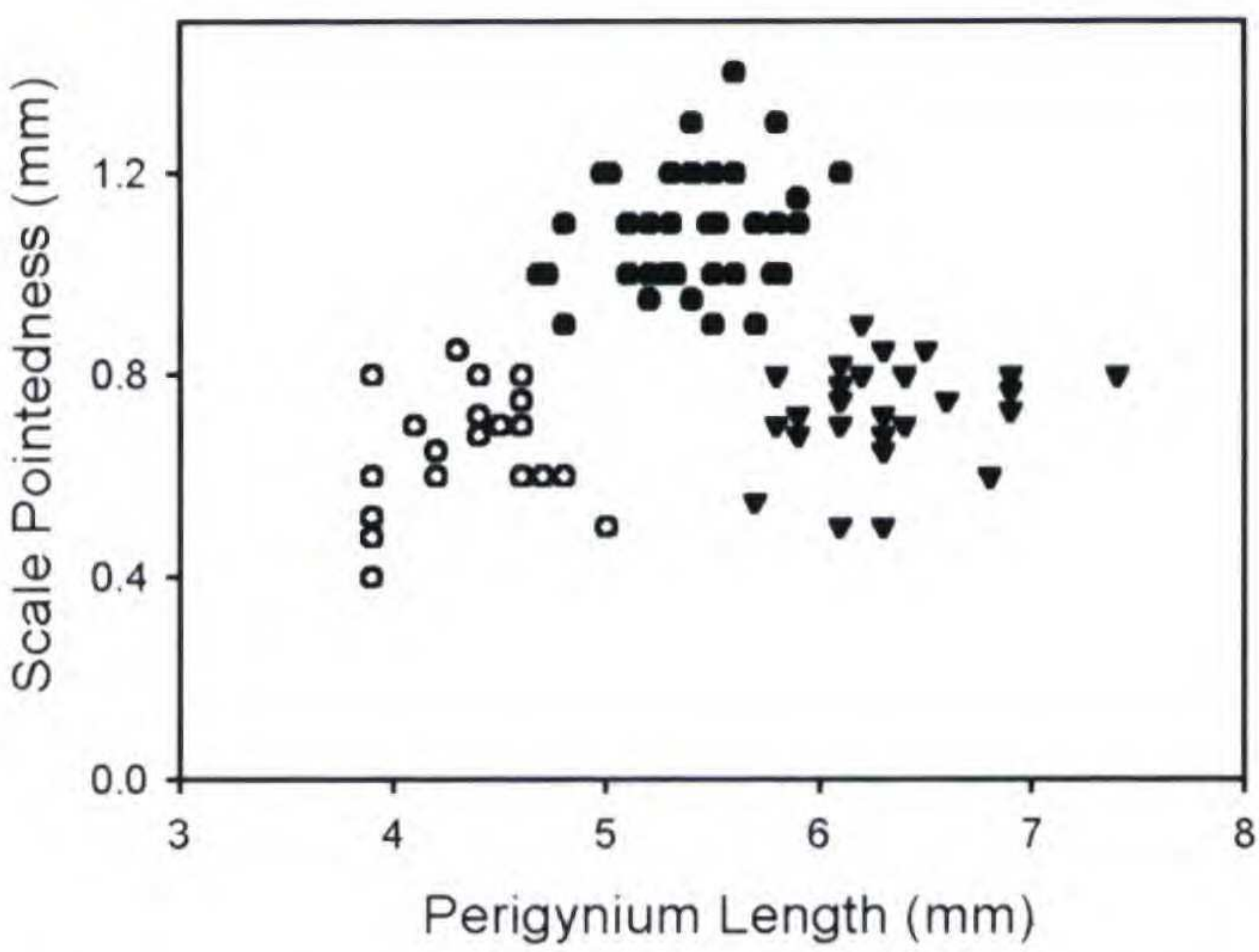


Figure 6. Scatter plot of perigynium length and pistillate scale pointedness of *Carex brevior* (circles), *C. opaca* (inverted triangles), and *C. shinnensis* (dots). Pointedness is the distance from the scale apex to where scale width equals 0.5 mm.

also proved valuable when confronted with poor-quality specimens of *C. shinnensis* and *C. opaca* in regions of geographical sympatry.

The following key distinguishes the species treated here from all the other members of the *Carex brevior* group. This includes all eastern North American members of Mackenzie’s (1931) “subsec-

tion” *Festucaceae* with very broadly elliptic to orbicular or even reniform perigynium bodies, these mostly also more than 2 mm wide. Eleven species are included here, out of a total of about 45 eastern North American species in section *Ovales*.

KEY TO THE *CAREX BREVIOR* GROUP INCLUDING *C. BICKNELLI* AND THE RELATED *C. OPACA* COMPLEX

- 1a. Plants colonial from short-creeping rhizomes; vegetative culms numerous and conspicuous, strongly tristichous and with 15 to 35 leaves when fully developed; achenes 1.6–2 times as long as wide (and 0.9–1.2 mm wide); larger spikes with 5 to 25(30) perigynia *C. hyalina*
- 1b. Plants definitely clumping (though rhizomes may appear elongate in old clumps); vegetative culms few, inconspicuous, and usually with fewer than 15(17) leaves, thus not strikingly tristichous; achenes 1–1.6(–1.7) times as long as wide (and 0.9–2.2 mm wide); larger spikes with 15 to 80 perigynia.
 - 2a. Perigynia finely granular-papillose (30–40×), the body reniform, 0.6–0.9 times as long as wide (and 3.2–4.9 mm wide); lower pistillate scales obtuse-rounded *C. reniformis*
 - 2b. Perigynia smooth, the body broadly ovate, elliptic, ± orbicular, or rarely slightly obovate, (0.7–)0.9–1.7 times as long as wide (and 1.5–6.1 mm wide); lower pistillate scales obtuse to acuminate-awned.
 - 3a. Larger perigynia 2.5–5.5 mm long, 1.5–3.6 mm wide, with beaks usually 0.7–1.6(–1.8) mm long; perigynia often plumply planoconvex or concavo-convex, the bulge formed by the achene prominent only on the abaxial face.
 - 4a. Leaf sheaths finely papillose at high magnification (30–40×); perigynia membranaceous, the brown achene clearly visible through the translucent adaxial face of the perigynium at maturity; usually at least some perigynia with the wings and base of beak irregularly erose, scalloped, or even with irregular teeth and often not symmetric.
 - 5a. Perigynia strongly and evenly 4- to 8-nerved over the achene on the adaxial face, (4.5–)5.1–5.5 mm long, wings usually strongly reddish brown tinged; pistillate scales usually reddish brown, usually (1–)1.4–2.3 mm shorter than the perigynia; anthers (2.4–)2.8–4.2 mm long *C. bicknellii*
 - 5b. Perigynia nerveless or faintly and irregularly 0- to 5(6)-nerved over the achene on the adaxial face, (2.3–)2.5–5.2(–5.5) mm long, wings yellowish tinged or greenish, pistillate scales yellowish tinged or greenish, 0.2–1.3 mm shorter than the perigynia; anthers (1–)1.3–2.6 mm long.
 - 6a. Perigynia 2.5–3.4 mm wide; distance from summit of achene to tip of beak 1.8–3.1 mm; achenes 1.3–1.5 mm wide *C. merritt-fernaldii*
 - 6b. Perigynia 1.5–2.4(–2.6) mm wide; distance from summit of achene to tip of beak 0.8–1.7(–2) mm; achenes (0.95–)1–1.3 mm wide *C. festucacea*
 - 4b. Leaf sheaths smooth; perigynia herbaceous, opaque, achene not clearly visible through the adaxial face of the perigynium, with the wings and base of beak usually finely and uniformly ciliate and ± symmetric.
 - 7a. Spikes on larger culms (3)5 to 7(11), tapered at the base, the terminal one with a

- conspicuous staminate base; inflorescences typically open, 2.5–4.5(–6.5) cm long with the lowest internodes (3–)4–13(–23) mm long; perigynium body (0.7–)0.9–1.3 times as long as wide (rarely to 1.6 in *C. shinnensis*).
- 8a. Larger achenes 1–1.3 mm wide, 1.2–1.8 mm long; larger perigynia 2.5–4(–4.2) mm long, 1.5–2.4(–2.6) mm wide, mostly 2- to 4(6)-nerved adaxially *C. festuacea*
- 8b. Larger achenes (1.2–)1.4–1.8 mm wide, (1.6–)1.7–2.2 mm long; larger perigynia 3.2–5.5 mm long, 2.5–3.6 mm wide, nerveless or faintly 1- to 5(7)-nerved adaxially.
- 9a. Larger perigynia 3.2–4.8(–5.2) mm long, beaks 0.8–1.5 mm long; pistillate scales acute, 3.3–4(–4.3) mm long, 2.3–2.9(–3.1) times as long as wide; achenes 1–1.3(–1.4) times as long as wide *C. brevior*
- 9b. Larger perigynia (4.6–)5–5.5 mm long, beaks 1.4–2.2(–2.4) mm long; longer pistillate scales acuminate to awned, (3.7–)4–5.2(–5.6) mm long, (2.6–)2.9–3.7(–4.2) times as long as wide; achenes (1.2–)1.4–1.7 times as long as wide.
- 10a. Staminate and lower pistillate scales acuminate-awned, the tip white to brownish-hyaline, membranaceous, often ± curled, the midvein evanescent before the tip; beaks of larger perigynia 2–2.6(–2.8) mm long; the body (1.3–)1.4–2.1 times as long as the beak *C. missouriensis* sp. nov.
- 10b. Staminate and lower pistillate scales acuminate, the tip firm and herbaceous, flat or inrolled, with the midvein prominent to the tip; beaks of larger perigynia 1.4–2.2 mm long; the body 1.8–2.6(–3) times as long as the beak *C. shinnensis* sp. nov.
- 7b. Spikes on larger culms 2 to 4(5), rounded at the base, the terminal one often lacking a conspicuous staminate base; inflorescences 1.2–3(–3.6) cm long with the lowest internodes 1.5–7(–13) mm long; perigynium body (0.7–)0.9–1.6 times as long as wide.
- 11a. Achenes of larger perigynia 0.9–1.3 mm wide, elliptic to narrowly oblong, 1.3–1.6 times as long as wide; larger perigynia 1.8–2.8(–3) mm wide, squarrose-spreading at maturity, (25)30 to 80 per spike *C. molesta*
- 11b. Achenes of larger perigynia 1.35–1.8 mm wide, broadly oblong to ± orbicular, 1–1.3 times as long as wide; larger perigynia (2.1–)2.5–3.4(–3.5) mm wide, appressed-ascending at maturity, (10)15 to 40(45) per spike.
- 12a. Perigynia nerveless or faintly and irregularly 1- to 5-nerved over achene on adaxial surface, the bodies (2–)2.3–3.2 mm long, ± orbicular (0.7–)0.9–1.1(–1.3) times as long as wide; pistillate scales mostly acute, about as long as to 0.7(–0.9) mm shorter than the subtended perigynium (flattened and measured separately); widespread *C. brevior*
- 12b. Perigynia strongly (3)4- to 7-nerved over achene on adaxial surface, the bodies (2.7–)3–4 mm long, broadly ovate to broadly elliptic, less often ± orbicular, (0.9–)1–1.6 times as long as wide; pistillate scales mostly obtuse, 0.7–1.7 mm shorter than the subtended perigynium (flattened and measured separately); Ozark Mountains, Cumberland Plateau, central Appalachians *C. molestiformis*
- 3b. Larger perigynia 5.5–8(–8.7) mm long, (3.1–)3.3–6.1 mm wide (except sometimes in *C. bicknellii* and *C. shinnensis*), with beaks (1.4–)1.6–2.5(–3.4) mm long; perigynia thin and ± wafer-like, ± biconvex around the achene, the bulge often prominent on both faces of the perigynia.
- 13a. Larger perigynia 4–6.1 mm wide, nerveless over achene adaxially, or nearly so; at least the lower staminate scales, especially of the terminal spike (and sometimes the lowermost pistillate scales) with the midrib excurrent as a scabrous awn 0.1–0.9(–2.4) mm long; larger culms with (2)3 to 4(5) spikes *C. tetrastachya* (= *C. brittoniana*)
- 13b. Larger perigynia (2.5–)2.7–4.8 mm wide, (0)1- to 8-nerved over achene adaxially; staminate and pistillate scales obtuse to acuminate-awned, but the midrib not excurrent as a scabrous awn; larger culms with (3)4 to 7(11) spikes.
- 14a. Leaf sheaths finely papillose, at least near the apex; perigynia membranaceous, the brown achene clearly visible through the translucent adaxial face of the perigynium, usually with reddish brown tinged wings, strongly and evenly 4- to 8-nerved adaxially over achene; pistillate scales usually reddish brown; plants in small clumps (usually < 25 culms) in dry to mesic habitats *C. bicknellii*
- 14b. Leaf sheaths smooth; perigynia herbaceous, opaque, achene not clearly visible through the adaxial face of the perigynium, with greenish or pale brown wings, finely and irregularly (0)1- to 7-nerved over achene adaxially; pistillate scales pale yellowish brown to brown; plants often in dense, large clumps (up to 200 culms) in wet habitats.
- 15a. Staminate and pistillate scales acuminate-awned, the tip white to brownish hyaline, membranaceous, often ± curled, the midvein evanescent before the tip;

- beaks of larger perigynia 2–2.6(–2.8) mm long; the body (1.3–)1.4–2.1 times as long as the beak *C. missouriensis* sp. nov.
- 15b. Staminate and pistillate scales obtuse to acuminate, the tip firm and herbaceous, flat or inrolled, with the midvein prominent to the tip; beaks (1.2–)1.5–2.1(–2.3) mm long; the body 1.9–3 times as long as the beak.
- 16a. Larger perigynia (5.6–)6–7.1 mm long, 3.3–4.6(–4.8) mm wide, exceeding the subtending scale by 1.5–2.6 mm; staminate and lower pistillate scales obtuse to acute; pistillate scales (2.2–)2.4–3.2(–3.4) times as long as wide *C. opaca* comb. nov.
- 16b. Larger perigynia 4.8–6(–6.3) mm long, (2.5–)2.7–3.8 mm wide, exceeding the subtending scale by (0.4–)0.6–1.4(–1.6) mm; staminate and lower pistillate scales acuminate; pistillate scales (2.6–)2.9–3.7(–4.2) times as long as wide *C. shinneryi* sp. nov.

SPECIES TREATMENT

1. *Carex bicknellii* Britton, in Britton & Brown, Ill. Fl. 1: 360. 1896. *Carex straminea* var. *crawei* F. Boott, Ill. Carex 3: 121. pl. 388. 1862, not *Carex bicknellii* E. G. Camus, in LeComte, Not. Syst. 1: 239. 1910 [= *Carex xanthocarpa* Bicknell]. TYPE: U.S.A. Michigan: *Crawe s.n.* (lectotype, here designated, K).

Caespitose in small clumps of up to 25 culms from short, thick, woody rhizomes; fertile culms (35–)40–110 cm tall, erect, trigonous, smooth or slightly scabrous-angled below inflorescence; bladeless basal sheaths dark brown to nearly black, disintegrating into conspicuous, short, dark brown fibers. Leaves 3 or 4, on lower 1/5–1/3 of the culm; blades 2.5–25 cm long, 2–5 mm wide, plicate, papillose adaxially, especially distally, the margins and midrib antrorsely scabrous distally; leaf sheaths ca. 2–16 cm long, tightly enveloping culms, papillose, at least on the main veins, green, the intervenal areas of the larger sheaths sometimes pale and with scattered septae; ventral sheaths with distinct V- to Y-shaped hyaline area reaching up to 20 mm below the orifice, the apex concave or truncate, extending up to 2.5 mm above the base of the blade; ligules 1–5 mm long, rounded to acute, the free portion entire and up to 1 mm long. Vegetative culms annual, few, ca. 20–60 cm tall, leaves 6 to 8, the lower 2 or 3 leaves evenly spaced along the culm, the rest clustered apically. Inflorescences 2.4–6.2 cm long, erect to arched or nodding, the spikes overlapping or the lowest separate, the lowest spikes 5–17 mm apart, spikes single at nodes, sessile; lowermost bracts 4.5–12 mm long, scale-like, but usually aristate-tipped, sheathless, upper bracts much reduced; spikes 3 to 6(8), gynecandrous, 7–21 mm long, globose to ovoid or turbinate, bases rounded to long-tapering, apices rounded, pistillate portion 5.5–11 × 5.5–12 mm, ca. 12- to 40-flowered, staminate portion 1.5–11 × 2–2.5 mm, ca. 4- to 20-flowered. Pistillate scales 3.1–5.4 × 1.2–2 mm, reaching at most to the base

of the perigynium beak, usually (1–)1.4–2.3 mm shorter than perigynia, lance-ovate to ovate, 1.9–3.2 times as long as wide, obtuse to acute or the uppermost acuminate, usually strongly reddish brown with narrow green center, 1-nerved with the nerve prominent nearly to the apex. Staminate scales 3.6–4.8 × 1.3–2.4 mm, ovate to lance-ovate, obtuse to acute, yellowish brown to reddish brown tinged, with green center and narrow hyaline margins, 1-nerved. Perigynia (4.5–)5.1–6.7(–7.1) × (2.4–)2.8–4.2 mm, 1.3–2.2 times as long as wide, glabrous, sessile, loosely ascending to somewhat spreading, concavo-convex, 0.5–0.7 mm thick, thin and membranous, very translucent over achene; bodies broadly elliptic to broadly ovate or nearly orbicular, 3.3–5.2 mm long, 1.1–1.7 times as long as wide and 2–3.7 times as long as beak, widest 1.5–2.5 mm above base, broadly thin-winged, wings 0.8–1.2 mm wide, the margins finely serrulate except near base and often erose, scalloped, or with an irregular tooth and not symmetric, contracted into a beak, green to pale whitish green with strongly reddish brown tinged wings, with 4 to 8 sharp nerves adaxially over achene, 6 to 9 nerves abaxially over achene and 2 to 3 nerves in winged margin; beaks (1.2–)1.4–2.2 mm long, strongly flattened and serrulate-margined to apex, the dorsal suture copper-brown, the apex bidentate with scabrous-margined teeth 0.1–0.5 mm long, distance from summit of achene to tip of beak 2.4–3.7 mm long. Achenes 1.6–2.2 × 1.1–1.6 mm, 1.2–1.6 times as long as wide, biconvex, elliptical to ± oblong, pale to dark brown, short-stipitate at base, apiculum 0.1–0.4 mm long; style straight; stigmas 2. Anthers 3, (2.4–)2.8–4.2 mm long. Chromosome numbers: $n = 38 \text{ II}$, 39 II .

The only previous report of a chromosome number for this species was $n = 38 \text{ II}$ (Table 1). Tanaka (1942) reported $n = 37 \text{ II}$ for *Carex bicknellii*. He obtained his material from Montréal, almost certainly through the very active and well known seed exchange of the Montréal Botanical Gardens. Plants

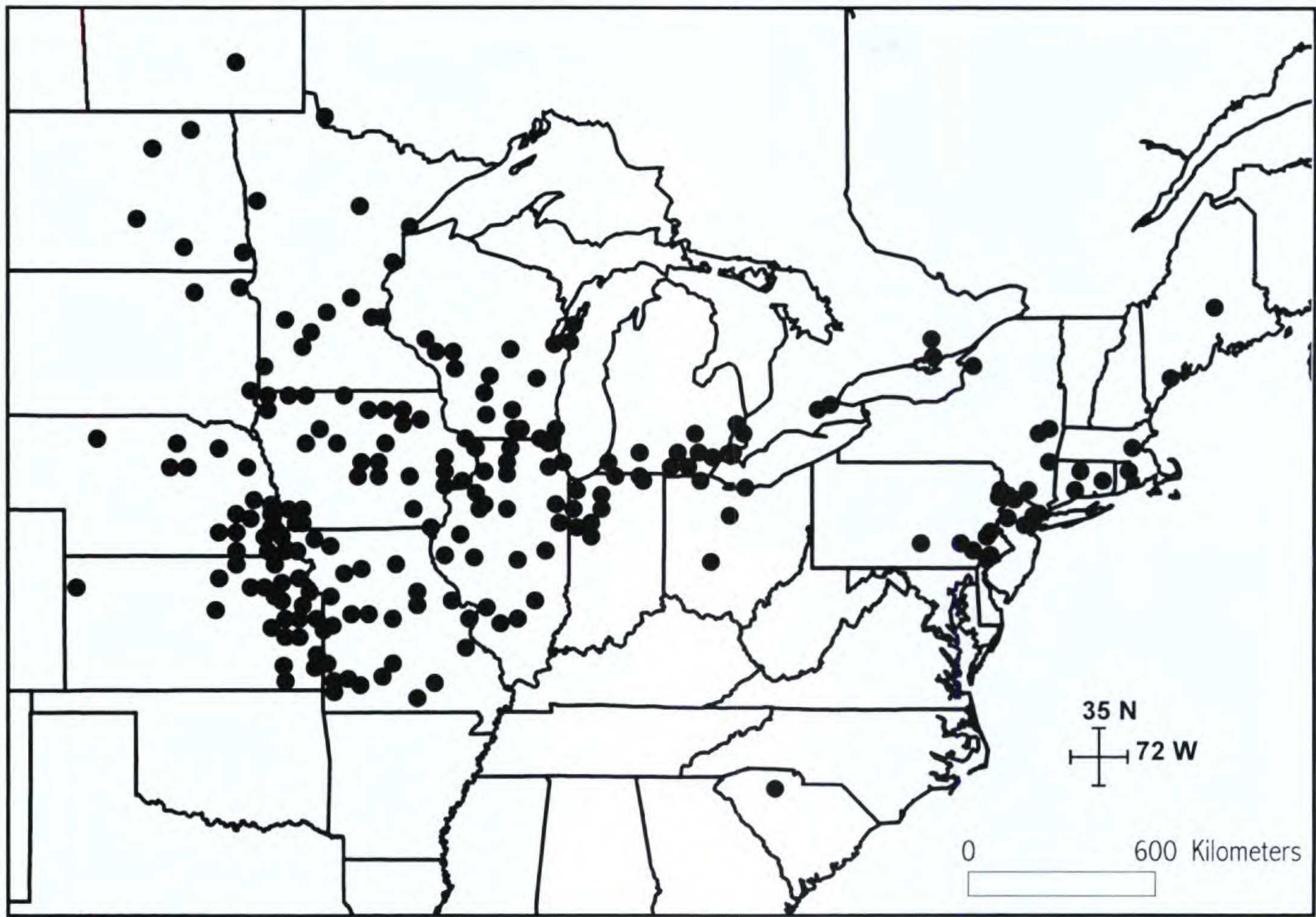


Figure 7. Geographical distribution of *Carex bicknellii*.

cultivated as *C. bicknellii* at the Montréal Botanical Gardens from 1936 to 1944 were brought in from a wild population at Contrecoeur, Québec (S. Hay, pers. comm. 2001). Material from this population has been determined by us as *C. merritt-fernaldii*. Tanaka's (1942) count for *C. bicknellii* is therefore here reported under *C. merritt-fernaldii*. Our additional counts of two plants from Illinois and two from Missouri all were $n = 38$ II or 39 II (Table 1).

Carex bicknellii mainly ranges from Missouri and southeast Kansas northward to southeast Manitoba and the western Lake Erie region (Fig. 7). Here it would have been a characteristic element of dry to mesic prairie communities. Disjunct populations occur in western Kansas, and the eastern Lake Ontario region. This species is also frequent on serpentine barrens, dry sandy or rocky fields, open woods, and thickets in an area from Connecticut to southeastern Pennsylvania and northern New Jersey, with colonies extending increasingly sparingly northward to southern Maine. The remarkable population from South Carolina is a component of a disjunct prairie community (Hill & Horn, 1997).

Putative hybrids with other species: none known.

Boott (1862) cited four syntypes for *Carex straminea* var. *crawei*, upon which *C. bicknellii* is

based: Michigan, *Crawe*; Wisconsin Prairies, *Lapham*; Darby Plains, Ohio, *Sullivan*; and Connecticut, *Barratt*. All the syntypes are extant in Boott's herbarium (K). Mackenzie (1931) noted for *Carex straminea* var. *crawei* "Type from Michigan." Though this notes only one of the four syntypes, it does not constitute a lectotypification, because it does not identify a single specimen as the lectotype. We concur, however, that the *Crawe* collection is the most suitable for lectotypifying *C. straminea* var. *crawei* because it was used by Boott for his illustration, and have selected the sheet in Boott's Herbarium.

Representative specimens. CANADA. **Manitoba:** Saskatchewan Plains, 1 Aug. 1872, *J. Macoun s.n.* (GH). **Ontario:** Brant Co., Brantford Twp., TCG prairie S of Hardy Rd., *W. Bakowsky* 285 (TRTE); Essex Co., Windsor, Ojibway Prairie, N side of Titcombe Rd. between Matchette and Malden Sts., *M. J. Oldham* 2782 (MICH); Hamilton-Wentworth Reg. Mun., Ancaster Twp., SW corner Paddy Greens Rd. and Powerline Road, *A. Goodban* 93-002 (TRTE); Hastings Co., Tyendinaga Twp., approx. 3 km WSW of Deseronto, *P. M. Catling & M. Oldham* 20321 (MICH); Lambton Co., Walpole Island, *L. O. Gaiser* 3614 (DAO); Lennox and Addington Co., Sheffield Twp., middle shore of Mellon Lake, 2 Aug. 1994, *P. M. & V. R. Catling s.n.* (MICH); Rainy River Dist., Spohn Twp., on shore of Lake of the Woods, *M. J. Oldham & W. D. Bakowsky* 20094 (MICH). U.S.A. **Connecticut:** Hartford Co., Avon,

F. C. Seymour 29808 (MO); New Haven Co., Wallingford, *L. J. Mehrhoff* 12725 (MICH); New London Co., Franklin, *R. W. Woodward* 19512 (MO). **Illinois:** Adams Co., prairie along RR, W of Paloma, *R. A. Evers* 107812 (ILLS); Cass Co., Beardstown, *S. R. Hill* 29202 (MICH); Champaign Co., Urbana, *A. S. Pease* 13083 (GH); Cook Co., Evanston, *A. S. Hitchcock* 198 (KSC); DuPage Co., Naperville, *L. M. Umbach* 871 (GH); Effingham Co., along railroad, SW of Mason, *R. A. Evers* 112957 (ILLS); Henry Co., Munson Cemetery, *R. R. Clinebell* 144, 146 (MO); Iroquois Co., S of Iroquois City, *R. A. Evers* 68890 (NCU); JoDaviess Co., 5 mi. W of Apple River, *F. J. Hermann* 8783 (GH); Kankakee Co., sand prairie, S of Talmadge, *R. A. Evers* 74080 (ILLS); Knox Co., Scots Cemetery, *R. R. Clinebell* 127 (MO); Lake Co., Lake Villa, *S. Viostak* 1933 (F); Lee Co., Co. Line Prairie, *R. R. Clinebell* 181 (MO); Macon Co., Decatur, *I. W. Clokey* 1035 (GH, US); Madison Co., Taag Station, *H. Eggert s.n.* (MO); Marion Co., prairie SW of Kinmundy, *R. A. Evers* 37265 (ILLS); Marshall Co., near Lawn Ridge, *V. H. Chase* 1404 (GH); McDonough Co., Emmet, East Fork of La Moine River NW of Macomb, *S. R. Hill with R. D. Henry* 29260b (MICH); Ogle Co., N of Davis Jct., *E. W. Fell* 499 (DAO); St. Clair Co., Hill prairie, *J. O. Neill* 10859 (ILLS); Starke Co., near Wady Petra, *V. H. Chase* 625 (MICH); Whiteside Co., Morrison RR, *R. R. Clinebell* 143 (MO); Winnebago Co., camp S of Bell Bowl in Greater Rockford Airport, *E. W. Fell* 56-115 (GH). **Indiana:** Benton Co., RR-siding 2 mi. NW of Earl Park, *F. J. Hermann* 6593 (MICH), 6598 (GH); Lagrange Co., along the Pigeon River, 2 mi. E of Mongo, *C. C. Deam* 20188 (PUL); Lake Co., S of Shelby near the Kankakee River, *C. C. Deam* 20142 (GH); Newton Co., along Penn Central RR, Lake Village, Lake Twp., 30 May 1970, *R. Schulenberg et al. s.n.* (MOR); Pulaski Co., sand dune near Thornhope, *S. McCoy* 1880 (BUT); St. Joseph Co., RR tracks, Christ the King Church, Niles Hwy., 5 June 1951, *P. E. Hebert s.n.* (DAO); Starke Co., S-side of Round Lake, 5 mi. SW of Knox, *R. M. Kriebel* 9539 (PUL); Tipton Co., W of Goldsmith, 30 May 1939, *C. M. Ek s.n.* (BUT); White Co., Railroad siding, 2 mi. S of Monon, *F. J. Hermann* 6062 (MICH). **Iowa:** Boone Co., Boone Prairie at jct. of Iowa 60 and US 30, *C. R. Gunn* 2456 (ISC); Bremer Co., Lageschulte Prairie, 1 mi. E and 0.5 mi. N of Waverly, *C. C. Freeman* 11043 (KANU); Cedar Co., along RR E of Mechanicsville, *B. Shimek* 21 (GH); Chickasaw Co., New Hampton, 26 June 1926, *W. D. Spiker s.n.* (ISC); Dickinson Co., Cayler Prairie, *M. L. Grant* 11568 (ISC); Emmet Co., prairies, Armstrong, 25 & 28 June 1855, *R. I. Cratty s.n.* (MO, NCU); Fayette Co., E of Hawkeye, 2 June 1921, *B. Shimek s.n.* (ISC); Floyd Co., Charles City, *Arthur s.n.* (ISC); Grundy Co., Reinbeck, *L. H. Pammel & B. B. Zimmerman* 276 (ISC); Iowa Co., Marshalltown, *C. R. Ball* 382 (GH, MO); Jasper Co., Rock Creek Twp., Sec. 7, 4 June 1956, *T. Van Bruggen s.n.* (BRIT); Jefferson Co., Chautauqua Park, Buchanan Twp., *C. L. Gilly* 2681 (ISC); Johnson Co., Iowa City, 11 June 1889, *A. D. Hitchcock s.n.* (ISC); Jones Co., dry sand and gravel along RR tracks, Oxford Twp., *T. S. Cooperrider* 1010 (NCU); Lee Co., Sec. 26, T66N, R6W, *J. L. Fults* 1488 (ISC); Lyon Co., Gitchie Manitou State Park, Sioux Twp., *A. Hayden* 8045 (ISC); Mills Co., 1½ mi. N of Haistings, 28 June 1983, *B. Wilson s.n.* (OMA); Montgomery Co., Erickson Prairie, *B. Wilson* 3846 (MICH, OMA); Muscatine Co., SE of Salisbury bridge, 11 June 1928, *B. Shimek s.n.* (ISC); Osceola Co., 2 mi. E of Harris, *R. H. Monson* 2310 (ISC); Page Co., N edge of Sec. 35, Tarkio Twp., 30 May 1989, *B. Wilson s.n.* (OMA); Pocahontas Co., Kalsow Prairie, Belleville Twp.,

J. D. Brotherson 1190, 1287 (NCU); Polk Co., Aukenny, 18 June 1923, *L. H. Pammel s.n.* (ISC); Sac Co., prairie relic between Hwy. #71 and railway, *P. H. Monson* 1832 (ISC); Scott Co., W Davenport, July 1897, *B. Miller s.n.* (ISC); Sioux Co., Hull, 1 July 1895, *N. Newrie s.n.* (ISC); Story Co., Ames, 16 June 1877, *J. C. Arthur s.n.* (GH); Webster Co., Fort Dodge, 14 June 1906, *R. I. Cratty s.n.* (ISC). **Kansas:** Anderson Co., 1 mi. S, 2 mi. W of Harris, *L. J. Harms* 1316 (KANU); Atchison Co., ½ mi. E of N city limits of Atchison, *H. W. Blocker* 579 (KSC); Bourbon Co., Hollister Wildlife Area, *R. L. McGregor* 40271 (KANU); Cloud Co., 6½ mi. E of Aurora near Mulberry Creek, *S. V. Fraser* 101 (KSC); Coffey Co., Wolf Creek site near Burlington, 8 June 1981, *E. W. Uhlemann s.n.* (OMA); Crawford Co., 5 mi. SW of Pittsburg, *R. L. McGregor* 9972 (KANU); Douglas Co., 5 mi. S of Lawrence on Haskett St., *O. A. Kolstad & L. J. Harms* 2160 (GH); Franklin Co., 4 mi. SW of Ottawa, *Hetzer* 203 (KANU); Jackson Co., 4 mi. N, 4 mi. E of Holton, Prairie Lake, *O. A. Kolstad & L. J. Harms* 2631 (GH, KANU); Johnson Co., 3 mi. S, 1 mi. W of jct. of Kill Creek Rd. and KS Hwy. 10, Kill Creek Prairie, *C. A. Morse* 1234 (KANU, MICH); Leavenworth Co., May 1896, *A. S. Hitchcock s.n.* (KSC); Lyon Co., NE corner, 4 June 1930, *F. Agrelius s.n.* (KSC); Miami Co., Paola, *B. Rohrer* 17 (KSC); Montgomery Co., Montgomery Co. State Lake area, *R. L. McGregor* 40408 (KANU); Nemaha Co., 4 mi. N of Bancroft, *G. Seiler & R. Brooks* 5156 (KANU); Neosho Co., Erie Township, N edge of Erie by Santa Fe RR, *W. W. Holland* 377 (KANU); Osage Co., Osage County State Lake, *R. L. McGregor* 40556 (KANU); Pottawattomie Co., 30 May 1899, *J. B. Norton s.n.* (GH); Riley Co., July 1897, *R. H. Pond s.n.* (GH); Saline Co., pasture land W of Salina, *J. Hancin* 1510 (KSC); Shawnee Co., Topeka, May 1895, *B. B. Smyth s.n.* (KSC); Sherman Co., Goodland, 30 July 1892, *B. B. Smyth s.n.* (KSC); Wabaunsee Co., E of Wabaunsee, *P. Maus* 232 (KSC); Washington Co., Washington County State Lake, 3 mi. W, 8 mi. N of Washington, *S. Stephens* 53871 (KANU); Wilson Co., 7 mi. E of Fall River on K96, *O. A. Kolstad* 1393 (KANU). **Maine:** Cumberland Co., Cumberland, *J. G. Blake s.n.* (US); Penobscot Co., terrace of Penobscot River, Bangor, *M. L. Fernald & C. A. Weatherby (Plantae Exsiccatae Grayanae* 529) (BRIT, BUT, DAO, GA, GH, ISC, KANU, MICH, MO, NCU, WIS). **Massachusetts:** Middlesex Co., Winter Pond, Winchester, *M. L. Fernald & B. Long* 8993 (GH); Norfolk Co., region N of Wellesley, 19 Oct. 1907, *K. M. Wiegand s.n.* (NY). **Michigan:** Jackson Co., N of Clear Lake, *F. J. Hermann* 6204 (GH, MICH, WIS); Livingston Co., Edwin S. George Reserve, *F. N. Hamerstrom, Jr.* 160 (DAO, MICH); Oakland Co., Royal Oak township, 12 Aug. 1920, *C. Billington s.n.* (MICH, US); St. Joseph Co., near Colon Jct., 1893, *C. F. Wheeler s.n.* (GH). **Minnesota:** Chippewa Co., Montevideo, *L. R. Moyer* 51 (US); Hennepin Co., vicinity of Minneapolis, June 1894, *J. H. Sandberg s.n.* (GH); Itasca Co. (?), Lake Pokegama Islands, *J. H. Sandberg* 273 (US, WIS); Meeker Co., Litchfield, June 1892, *W. D. Frost s.n.* (GH); Norman Co., beside hwy. #32, 10 mi. S of Fertile, *J. W. Moore & E. P. Thatcher* 14342 (BRIT); Pipestone Co., Pipestone National Monument, Unit 5, 7 July 1984, *D. Becker s.n.* (OMA); Redwood Co., about 7 mi. S of Sacred Heart, *J. W. Moore & C. O. Rosendahl* 13318 (GH, ISC); Renville Co., granite outcrops at Morton, *J. W. Moore* 13059 (US, WIS); St. Louis Co., Enger Golf Course, Duluth, *O. Lakela* 5079 (BRIT); Sherburne Co., St. Cloud airport, 21 June 1984, *L. E. Lindstrom s.n.* (KSC); Washington Co., northern outskirts of Afton village near Minn.

Rte. 95, *G. B. Ownbey* 5567 (BRIT, DUKE, NCU, OKL, WIS). **Missouri:** Atchison Co., 1.5 mi. E of Nodaway Co. line and 3 mi. S of C, MacKay Prairie, *D. Castaner et al.* 5704 (MO); Audrain Co., 5.4 mi. W of Thompson, S side of Mo. Hwy. 22 along Norfolk and Western Railway, *A. A. Reznicek et al.* 10193 (MICH, MO); Barton Co., Leroy Twp., remnant prairie lot, *D. Castaner* 6899 (MO); Bates Co., Amsterdam Prairie, July 1994, *H. Loring s.n.* (MO); Caldwell Co., 1.2 mi. W of Rte. A+M Jct., ca. 9.5 mi. E of Hamilton, *A. A. & S. A. Reznicek* 9840 (BRCH, Hb. C. T. Bryson, FTG, KNK, MICH, MO); Callaway Co., Kingdom City, Tucker Prairie, ca. 2.5 mi. WNW of Jct. Hwy. 54 and I-70, *A. A. Reznicek et al.* 10190 (MICH, MO, VPI, WIS); Cass Co., ca. 3 mi. NW of Archie, Dorsett Hill Prairie, *T. E. Smith* 2526 (MO); Christian Co., 1 mi. W of Billings, jct. Hwys. 13 and 60, 22 May 1986, *D. Castaner s.n.* (MO); Gentry Co., along road Z, 2.8 mi. W of Berlin, *J. A. Steyermark* 76302 (BRIT); Holt Co., Little Tark Prairie, ca. 1 mi. W of County Hwy. C and 1.75 mi. N of US Hwy. 59, 3 mi. E of Craig, *G. Yatskievych & B. Summers* 93-199 (MO); Howell Co., Willow Springs, *F. W. Pennell* 11631 (ISC); Jackson Co., Waldo Park, *B. F. Bush* 652 (KSC, MO); Jasper Co., Sarcxie, *E. J. Palmer* 3674 (GH); Johnson Co., about 7 mi. NE of Warrensburg, *D. Castaner* 2221 (BRIT, MO); Laclede Co., Lebanon, *F. W. Pennell* 11663 (ISC); Lawrence Co., ca. 2.5 mi. E of Stotts City, *G. & K. Yatskievych et al.* 97-09 (MO); Lincoln Co., Sherwood Prairie, *B. Schuette* 2606 (MO); Livingston Co., RR embankment NE of Chillicothe, *S. Sparling* 834 (ISC); Macon Co., Long Branch State Park, ca. 1.5 mi. NNE of jct. Rte. 72 and 62, NE of Bertrand, *P. M. McKenzie with K. McCarty* 1588 (MICH, MO); Moniteau Co., along Hwy. 50 W of California, *J. A. Steyermark* 65475 (F); Newton Co., Diamond Grove Prairie Natural Area, ca. 3.5 mi. W of Diamon and 1 mi. N of County Hwy. V, *G. Yatskievych et al.* 94-81 (MO); Nodaway Co., ca. 1/4 mi. W of NWSMU-Maryville campus, *T. E. Smith* 3233 (MO); Pettis Co., Drover's Prairie, 10 mi. S of Sedalia on Hwy. 65, 1 mi. W, 22 June 1989, *K. Kindscher s.n.* (KANU); St. Francois Co., St. Francois State Park-Coonville Creek fen, *P. M. McKenzie with B. Jacobs* 1697 (MICH, MO); St. Louis Co., Normandy, St. Louis, 18 May 1918, *J. R. Churchill s.n.* (GH, ISC); Shannon Co., *B. F. Bush* 16 (US); Webster Co., S-side of Hwy. US 60 along St. Louis-San Francisco RR, *A. E. Brant & R. E. Gereau* 556 (GH). **Nebraska:** Cass Co., Weeping Water, *J. M. Bates* 5121 (GH); Fillmore Co., 2½ mi. W of Fairmont, *S. Stephens* 48572 (KANU); Holt Co., Inman, 20 June 1899, *J. M. Bates s.n.* (GH); Johnson Co., 4 mi. S and 1/4 mi. E of Tecumseh, *S. Stephens* 3892 (KANU); Lancaster Co., Lincoln, Flader prairie, *W. Kiener* 19227 (BRIT, DAO); Pawnee Co., 2 mi. N and 3 mi. E of Burchard, *S. Stephens* 53698 (KANU); Richardson Co., SW of Salem, *H. C. Reynolds* 1655 (DAO); Sarpy Co., Fricke Prairie, about 1.3 mi. ENE of 72nd and Cornhusker, *S. Lamphere* 1179 (OMA). **New Jersey:** Bergen Co., Closter, *C. F. Austin s.n.* (GH); Passaic Co., sandy fields, Clifton, 28 June 1917, *J. A. Ruth s.n.* (US); Sussex Co., between Stockholm and Hamburg, 19 May 1894, *C. L. Pollard & W. M. Van Sickle s.n.* (US); Union Co., #9 Park Ave., Plainfield, *W. D. Miller* 535 (US); Warren Co., near Stillwater, *L. Griscom* 9735 (GH). **New York:** Albany Co., Glenmont, *H. D. House* 7875 (GH); Dutchess Co., Little Stissing Mountain, 14 May 1881, *C. H. Peck s.n.* (GH); Jefferson Co., Watertown, *J. B. Craze s.n.* (GH); Orange Co., Durland Hill, Chester, *H. K. Svenson* 8425 (DAO); Rensselaer Co., Troy, *Williams s.n.* (GH); Rensselaer Co., N of North Chatham

close to Columbia Co. line, *H. D. House* 27318 (US); Sussex Co., S of Sussex, Long Island, Cold Spring Harbor, *S. A. Cain* 112 (BRIT, MO). **North Dakota:** Benson Co., Leeds, 23 July 1912, *J. Lunell s.n.* (BUT); Cavalier Co., Langdon, *S. L. Rider* 113 (F); LaMoure Co., Adrian, *H. F. Bergman* 1807 (OKL); Richland Co., Walcott, *O. A. Stevens* 1259 (US, WIS); Stutsman Co., Central Grasslands Research Station, *C. L. Lura* 217 (NDA). **Ohio:** Crawford Co., Dallas Twp., Daughter Savanna, W side Marion-Melmore Road, 1 mi. N of SR 294, *G. Schneider* 1998:62, *E. Reed* (OS); Erie Co., Old Woman Creek State Nature Preserve, *J. K. Bissell et al.* 1990:064 (MICH); Lucas Co., W side of sec. 11, about 7 mi. NW of Maumee, *C. C. Deam* 5962 (IND); Madison Co., Monrow Twp., W. Pearl King Prairie Oak Grove, NW corner Brown Road and Sanford Road (CR 27), *G. Schneider* 1993:243 (OS). **Pennsylvania:** Chester Co., serpentine barrens, Westtown, *J. H. Painter* 656 (GH, MO); Delaware Co., Williamson, *F. W. Pennell* 3783 (MICH, MO); Montgomery Co., along Schuylkill River, Ivy Rock, *B. Long* 7330 (GH). **Rhode Island:** county, town, and date unknown, *J. W. Congdon s.n.* (US). **South Carolina:** Union Co., Co. Rt. 25, 0.95 mi. W of Co. Rt. 33, W of Buffalo, *S. R. Hill* 25886 (MICH). **South Dakota:** Brown Co., 17 mi. N, 9 mi. W of Aberdeen, *S. Stephens* 48891 (KANU); Roberts Co., Seiche Hollow, 8 mi. W, 6 mi. N of Sisseton, *S. Stephens & R. Brooks* 14490 (KANU). **Wisconsin:** Brown Co., Ashwaubenon, June 1885, *J. H. Schuette s.n.* (F, GH); Dane Co., along RR right-of-way, W edge of Dunn's Marsh, Madison, *J. H. Zimmerman* 1695 (DAO); Door Co., Sturgeon Bay, 11 July 1885, *J. H. Schuette s.n.* (F); Green Lake Co., Berlin, *P. E. Hebert* 1287 (ND); Jackson Co., along Rte. 54 about 4.7 mi. E of Black River Falls, *V. E. McNeilus* 89-493 (MICH, MO); Juneau Co., prairie by Hwy. 12-16, on C.M. St. P. & P. RR bank, Delton, *J. H. Zimmerman* 2003 (DAO); Monroe Co., Sparta, *H. C. Benke* 1535 (F, US); Racine Co., Racine, 1880, *J. J. Davis s.n.* (GH); Rock Co., N of Newark Road, S ½ of Sec. 13, Newark Twp., *E. & L. Musselman* 4603 (NCU); Rock Co., prairie remnant, T2N, R13E, *T. S. Cochran* 698 (NCU, WIS).

2. *Carex merritt-fernaldii* Mackenzie, Bull. Torrey Bot. Club 49: 370. 1922 [1923]. TYPE: U.S.A. Maine: Penobscot Co., gravelly esker, lower Penobscot Valley, Orono, 3 July 1897, *M. L. Fernald s.n.* (holotype, GH; isotypes, GH, MO).

Carex brevior var. *pseudofestucea* Farwell, Pap. Michigan Acad. Sci. 2: 18. 1923 [1924]. *Carex festucea* sensu Fernald, Proc. Amer. Acad. Arts 37: 477. 1902, not *Carex festucea* Schkuhr ex Willd., Sp. Pl. 4(1): 242. 1805. TYPE: U.S.A. Maine: Penobscot Co., gravelly esker, lower Penobscot Valley, Orono, 3 July 1897, *M. L. Fernald s.n.* (lectotype, here designated, GH; isolectotypes, GH, MO).

Caespitose in dense clumps of up to ca. 25(to 30) culms from very short, woody rhizomes; fertile culms 40-120 cm tall, erect, trigonous, smooth except for finely scabrous angles just below inflorescence; bladeless basal sheaths pale to dark brown, disintegrating into short, brown fibers. Leaves 3 to 5, on lower 1/5-1/3 of the culm; blades 2-40 cm

long, 1.5–4.5 mm wide, plicate, glabrous or papillose adaxially, the margins and midrib smooth to antrorsely scabrous; leaf sheaths ca. 1.5–17 cm long, tightly enveloping culms, papillose, green, the intervenal areas of larger sheaths sometimes pale and with scattered green septae; ventral sheaths with a distinct Y-shaped hyaline area reaching 0–7(–10) mm below the orifice, its apex concave or truncate, extending 0–1.5 mm above the base of the blade; ligules 1.5–5 mm long, rounded, the free portion entire and up to 1.7 mm long. Vegetative culms annual, few, ca. 20–45 cm tall during fruiting season, leaves 5 to 9, the lower 2 or 3 leaves evenly spaced along the culm, the rest clustered apically. Inflorescences (1.8–)2.2–6.1 cm long, erect to arched or nodding, the spikes overlapping or the lower 2 to 4 well separated, the lowest spikes 2–13 mm apart, spikes single at nodes, sessile; lowermost bracts 3–12(–17) mm long, rarely aristate bristle-tipped, seldom exceeding the spike, sheathless, upper bracts much reduced; spikes (4)5 to 8(9), gynecandrous, 8–20 mm long, globose to ovoid, bases rounded to acute, apices obtuse, pistillate portion 7–11 × 6–8(–10) mm, ca. 15- to 60-flowered, staminate portion 1–9.5 × 1–2 mm, ca. 4- to 12-flowered. Pistillate scales 3.2–4.5(–4.7) × 1–1.7 mm, reaching from the middle to near the apex of the perigynium beak, 0.4–1 mm shorter than the perigynia, 2.2–3.4 times longer than wide, lanceolate to narrowly ovate, acute, pale yellow to medium brown, with narrow yellowish green center and hyaline margins, 1-nerved or faintly 3-nerved, the midnerve extending essentially to the tip. Staminate scales 3–4.6 × 1.4–2 mm, ovate to lanceolate, obtuse to acuminate, pale yellow to light brown, with narrow yellowish green center and hyaline margins, 1-nerved or faintly 3-nerved. Perigynia 3.6–5.2(–5.5) × 2.5–3.4 mm, 1.3–2.3 times as long as wide, glabrous, sessile, appressed-ascending, concavo-convex except over the achene, 0.5–0.8 mm thick, \pm thin and membranous, translucent over achene; bodies elliptic to \pm orbicular, 3–4.1 mm long, 1–1.4 times as long as wide and 2.8–4.2 times as long as beak, widest 1.2–2.2 mm above base, broadly thin-winged, wings 0.6–1.1 mm wide, the margin finely serrulate except near base, often erose, scalloped, or with irregular teeth in the shoulder area, abruptly contracted into a beak, the wing margin pale yellow to yellowish brown tinged, faintly and irregularly 0- to 5(6)-nerved adaxially over achene, 6- to 8-nerved abaxially over achene and 2- or 3-nerved in the winged margin; beaks 0.7–1.4 mm long, strongly flattened and serrulate-margined to apex, the dorsal suture hyaline to brown, the apex inconspicuously biden-

tate with teeth 0.1–0.4 mm long, distance from summit of achene to tip of beak 1.8–3.1 mm. Achenes 1.4–1.8 × 1.3–1.5 mm, 1.1–1.4 times as long as wide, biconvex, elliptical to \pm orbicular, pale to dark brown, short-stipitate at base, apiculum 0.1–0.4 mm long; style straight; stigmas 2. Anthers 3, 1.3–2.6 mm long. Chromosome number: $n = 35$ II, 37 II.

Previous reports of the chromosome number for *Carex merritt-fernaldii* were $n = 35$ II (Tanaka, 1942) and $n = 37$ II (Tanaka, 1942; Rothrock & Reznicek, 1998). These plants came from near Montréal, Canada (Tanaka), and Strafford Co., New Hampshire. The new report of $n = 37$ II (Table 1) comes from Lucas Co., Ohio, a disjunct population forming the southern extreme of this species' range.

Carex merritt-fernaldii occurs from eastern Manitoba eastward to southern Québec, Maine, and barely into New Brunswick and south to southwestern Wisconsin and northwestern Ohio (Fig. 8). It is frequent in parts of New England, reaching as far south as Long Island, New York. It is a species of early successional communities, appearing, presumably out of the soil seed bank, after physical disturbance or fire, and gradually dying out as the habitat matures. Typical habitats include sandy or gravelly roadsides and ditch banks, sand barrens, gravel and sand pits, and rock ledges, always in relatively sterile, acidic soils. Because *C. merritt-fernaldii* requires open habitat with well-drained, leached, acidic, sandy or gravelly soils, it is lacking in large portions of southern Ontario, southern Michigan, and western New York State where calcareous or finer textured soils predominate. Reports of this species from Indiana are based upon misidentifications.

Putative hybrids with other species: none known.

Vegetatively, *C. merritt-fernaldii* and *C. bicknellii* are very similar. Both possess coriaceous herbage, stocky, papillose culm bases, and relatively few shoots per tussock. In flower or fruit, the two species can be separated as described in the key. Anthers of *C. merritt-fernaldii* are notably shorter. Likewise the perigynia of *C. merritt-fernaldii* are, on average, shorter (4.18 ± 0.35 mm ($N = 30$) compared to *C. bicknellii*, 5.64 ± 0.53 mm ($N = 33$), Fig. 9) as well as narrower. Their beaks, compared to *C. bicknellii*, are more abruptly tapered from the body. Also, in *C. merritt-fernaldii* the ventral nerves over the achene are not only faint, but average near 2 compared to greater than 5 for *C. bicknellii*. Achene length and shape further differentiate the two species. Those of *C. bicknellii* have an average length of 1.95 ± 0.09 mm compared to

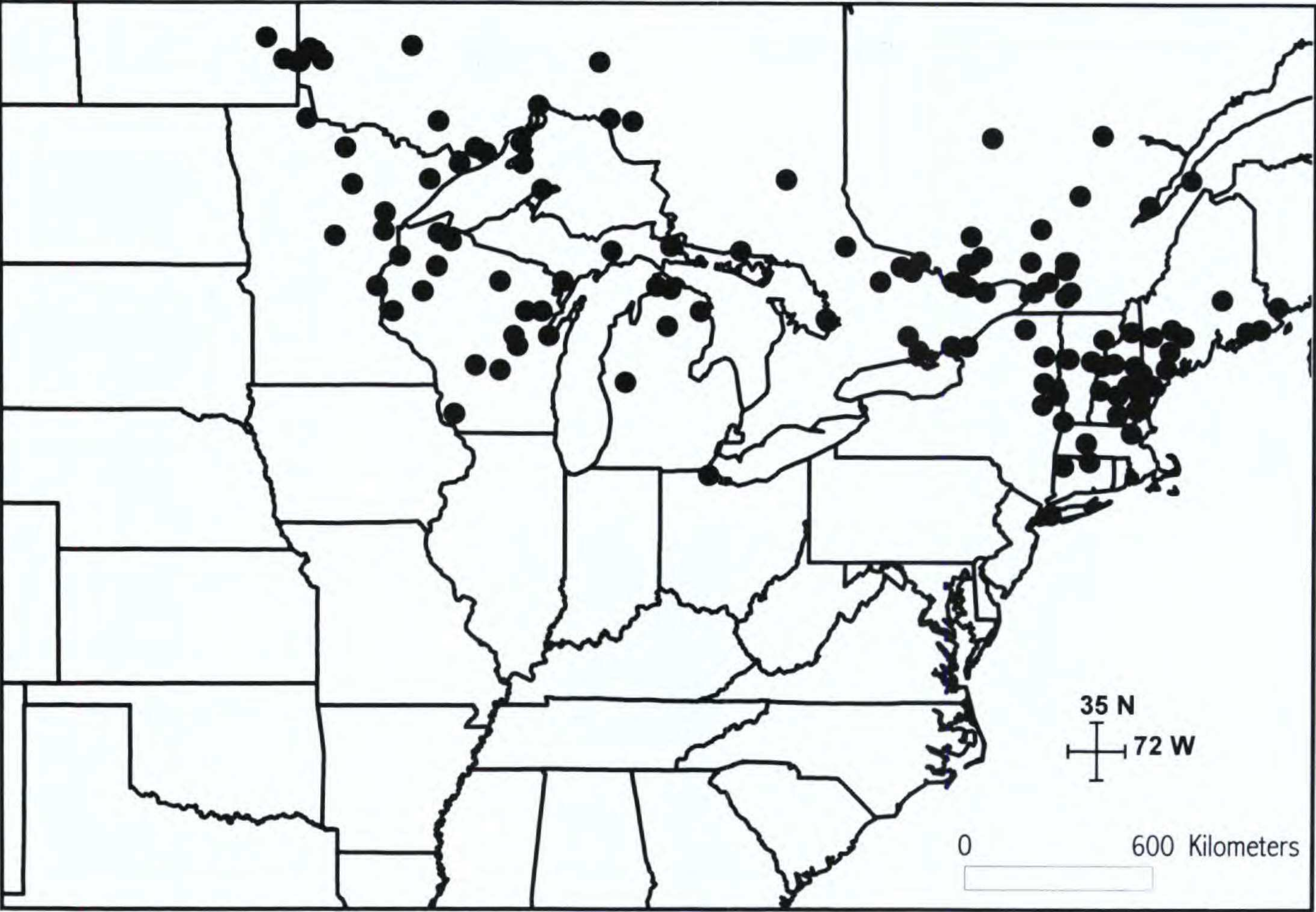


Figure 8. Geographical distribution of *Carex merritt-fernaldii*.

only 1.67 ± 0.10 mm for *C. merritt-fernaldii* (Fig. 9). However, both species have achene widths of approximately 1.3 mm. Inflorescences of *C. merritt-fernaldii* may have as many as 8(9) spikes, while those of *C. bicknellii* typically range from 3 to 6.

In spite of the differences between these sedges, the xeric environment can result in sufficient phenotypic plasticity to occasionally make separation based upon quantitative characters difficult. Mature material resolves this problem in that *C. bicknellii*

perigynia possess translucent, reddish brown tinged wings and pistillate scales with reddish brown coloration. In contrast, *C. merritt-fernaldii* retains a yellowish tone to its perigynia and scales into maturity.

Both *Carex merritt-fernaldii* and *C. brevior* var. *pseudofestuceacea* were explicit replacements for the species Fernald (1902) described under the misapplied name “*Carex festuceacea* Schkuhr.” However, while Mackenzie (1922) provided his own careful description of *C. merritt-fernaldii* and designated a holotype, Farwell (1923) provided only a reference to Fernald’s description. The lectotypification of Farwell’s name, therefore, must be based on specimens Fernald used in his description of his “*Carex festuceacea* Schkuhr.” The Fernald collection cited by Mackenzie as the holotype of *C. merritt-fernaldii* fits this criterion, and we choose as lectotype of the Farwell name the holotype of *Carex merritt-fernaldii*.

Representative specimens. CANADA. **Manitoba:** Lac Du Bonnet, A. J. Breitung 7462 (DAO); near Rennie, R. Sparling 234 (DAO); Lake Winnipeg Valley, 1857, Bourgeau s.n. (GH); 4 mi. SE of Caddy Lake, D. Löve & H. J. Scoggan 6483 (WIN). **New Brunswick:** Charlotte Co., summit of Chamcook Mtn., H. R. Hinds 11482 (UNB). **Ontario:** Algoma Dist., Hwy. 17, ca. 3 km E of Cutler, Serpent River IR 7, M. J. Oldham & M. Delisle-Oldham

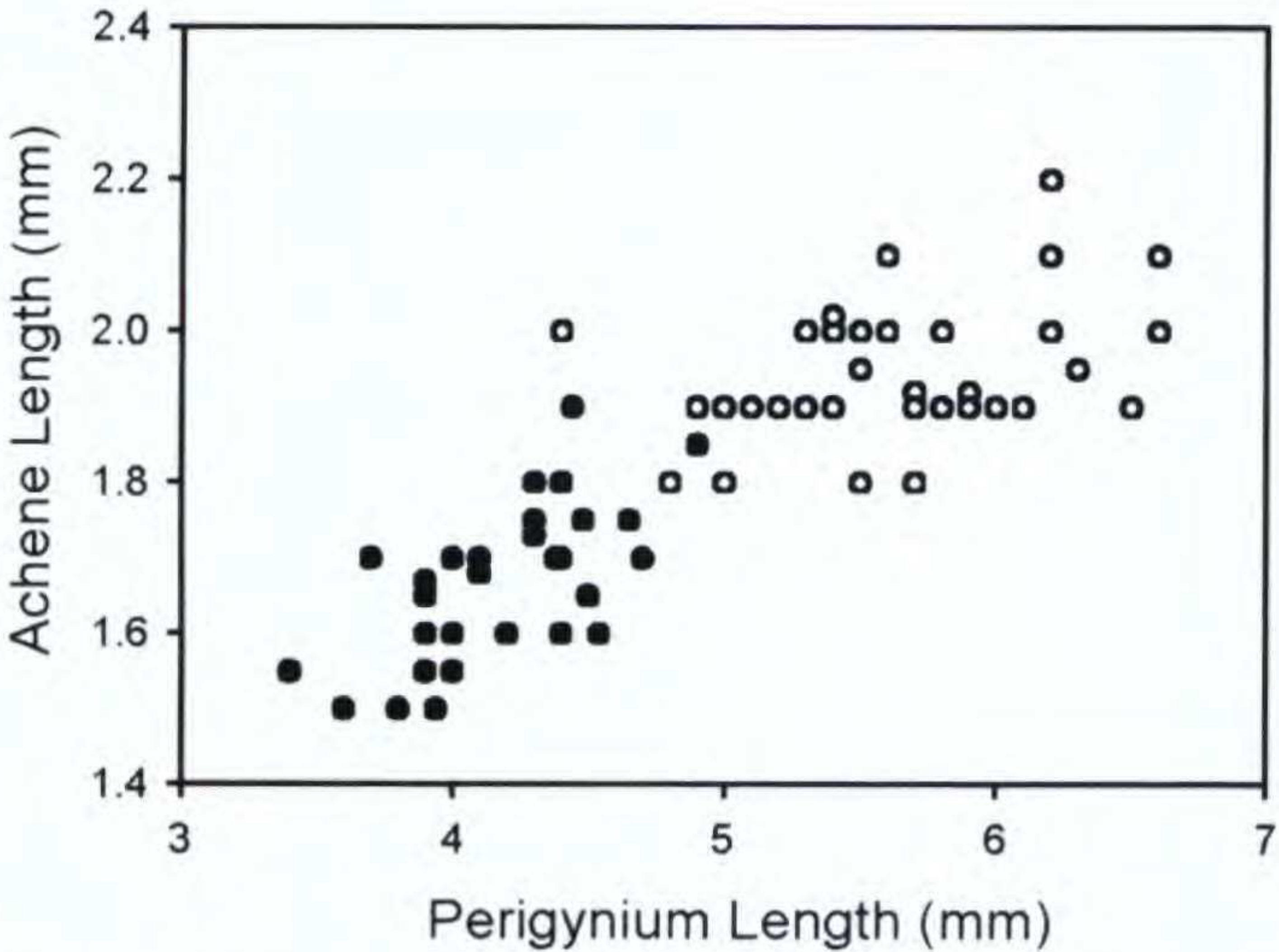


Figure 9. Scatter plot of perigynium length and achene length of *Carex bicknellii* (circles) and *C. merritt-fernaldii* (dots).

9624 (Hb. C. T. Bryson, MICH); Carleton Co., Torbolton Twp., Constance Bay area, *J. A. Calder* 406 (DAO); Frontenac Dist., Kingston Mills, 30 June 1906, *A. B. Klugh* s.n. (DAO, GH); Kenora Dist., Gundy Twp., Ingolf, *M. J. Oldham* 9813 (DAO, MICH, TRTE); Rainy River Distr., Hwy. 11, 62.4 road mi. E of Fort Francis, *M. J. Oldham & M. Delisle-Oldham* 9756 (MICH); Renfrew Co., Stafford Twp., Shady Nook, *W. H. Minshall* 2091 (F); Simcoe Co., Tiny Twp., near Macey Lake, ca. 6.5 km NW of Penetanguishene Post Office, *M. J. Oldham et al.* 18101 (MICH); Thunder Bay Dist., N end of Government Bay, White Lake, ca. 16 mi. NW of town of White River, *E. G. Voss* 10472 (DAO, MICH); Lake Nipigon, 11 July 1884, *J. Macoun* s.n. (GH); Longlac, *E. Lepage* 38130 (DAO, GH). **Québec:** Lac à Beauce, 8 mi. S of LaTuque, *A. & D. Löve* 7249 (DAO, MT); Cté. Berthier, Lanoraie, *FF. Marie-Victorin & Rolland-Germain* 49214 (F, GH, MT); Cté. Gatineau, Parc de la Gatineau, *D. Gagnon* SIM-5 (MT); Cté. Iberville, Mont-Saint-Gregorie, 28 June 1949, *M. Raymond* s.n. (MT); Cté. Lac St.-Jean, Lac Val Jalbert, 8 July 1953, *L. Cinq-Mars* s.n. (MT); Cté. Montmorency, Cap-Tourmente, Saint-Joachim, *V. Gerardin & G. Lemieux* 4560 (DAO); Cté. Pontiac, Bristol Twp., Pontiac Station on Ottawa River, *J. A. Calder & A. J. Breitung* 4800 (DAO, MT); Cté. Rouville, Rougemont, *F. Rolland-Germain* 6092 (BRIT, GH, MO, NY). U.S.A. **Connecticut:** Lichtfield Co., 1 mi. S of Bethlehem, *F. J. Hermann* 11874 (MICH); Tolland Co., Union E of jct. I-84 (E) and Rte. 190, *A. A. Reznicek, L. Mehrhoff et al.* 10323 (CONN, MICH). **Maine:** Androscoggin Co., Leeds, 23 July 1916, *C. H. Knowlton* s.n. (KANU); Cumberland Co., Standish, Sebago Lake, *A. H. Norton & H. Fuller* 12594 (MO, NHA); Franklin Co., Farmington, 9 July 1911, *C. H. Knowlton* s.n. (MO); Hancock Co., Hwy. 182 at jct. with road to Tunk Mountain, ca. 11 mi. W of Cherryfield, *A. A. & S. A. Reznicek* 9637 (BRCH, Hb. C. T. Bryson, KNK, MICH); Oxford Co., 5.9 mi. W of West Bethel, *A. A. & S. A. Reznicek* 9119 (BRIT, Hb. C. T. Bryson, MICH, TAES, VDB); Penobscot Co., Veazie, *O. W. Knight* 4550 (MICH, NHA, NY); Washington Co., 5.3 mi. NW of Jonesboro (at US 1), *A. A. & S. A. Reznicek* 10067 (BRCH, Hb. C. T. Bryson, DAO, KNK, MAINE, MICH, TRTE, UNB, VDB, VPI, WIN); York Co., Hollis, 3 mi. W of Bar Mills, *A. H. Norton et al.* 17793 (NHA). **Massachusetts:** Hampshire Co., King Street, Northampton, *H. E. Ahles* 79993 (APCR); Middlesex Co., Melrose, 29 June 1876, *T. Morong* s.n. (F, NY); Worcester Co., South Ashburnham, on sandy RR embankment, *F. F. Forbes* 871 (GH). **Michigan:** Cheboygan Co., Douglas Lake, *J. H. & L. S. Ehlers* 2363 (MICH, NY); Chippewa Co., Sheldrake, *M. L. Fernald & A. S. Pease* 3161 (GH, MICH); Emmet Co., N of Pellston, *L. S. Ehlers* 296 (MICH, NY); Keweenaw Co., E of Lake Bailey, *F. J. Hermann* 7781 (MICH, NY); Muskegon Co., Muskegon, *McClatchie* 48 (GH); Schoolcraft Co., dry sandy plain near Driggs, *M. L. Fernald & A. S. Pease* 3163 (GH). **Minnesota:** Carlton Co., June 1891, *J. H. Sandberg* s.n. (MO, US); Cook Co., W side of North Fowl Lake, *F. K. Butters, E. C. Abbe & G. W. Burns* 669 (GH); Crow Wing Co., Garrison, June 1892, *E. P. Sheldon* s.n. (DUKE, KANU, US); Hennepin Co., shady hillsides, *J. H. Sandberg* 5 (BH); Lake of the Woods Co., 1/4 mi. W of Pine Creek, Angle Inlet, *J. W. & M. Moore* 10932 (NY); St. Louis Co., Prairie Lake, *O. Lakela* 9355 (DAO). **New Hampshire:** Belknap Co., Rattlesnake Island, 6 June 1965, *W. H. Berry, Jr. & A. R. Hodgdon* s.n. (NHA); Carroll Co., Effingham, *F. C. Seymour* 19835 (MO); Coos Co., Diamond Peak, Darmouth College Grant, *A. R. Hodgdon & F. Steele*

9384 (NHA); Grafton Co., Wentworth, *F. C. Seymour* 25581 (BRIT, MO); Hillsborough Co., Peterborough, 25 July 1932, *L. Griscom* s.n. (F); Rockingham Co., Fremont, off Ridge Rd., *E. J. Hehre with A. R. Hodgdon* 201 (MO); Strafford Co., Durham near old RR Depot, *E. J. Hehre* 203 (MO); Sullivan Co., 1.8 mi. S of jct. NH Rt. 11-103 and 10, Newport, *H. E. Ahles* 68478 (NHA). **New York:** Essex Co., S of St. Huberts, Keene Valley, *H. D. House* 27796 (GH, NY); Franklin Co., Adirondack Park, 0.3 mi. E of Franklin Falls, *A. A. & S. A. Reznicek* 9909 (BRCH, DAO, KNK, MICH, NYS); Jefferson Co., vic. of South Bay, Wellesley Island, 28-30 June 1902, *T. R. Robinson & W. R. Maxon* s.n. (F, GH); Saratoga Co., Middle Grove, 20 July 1901, *C. H. Peck* s.n. (GH); Warren Co., 1/4 mi. S of Schroon Lake outlet, near Pottersville, *H. D. House* 27505 (NY); Washington Co., N of Copeland Pond, W. Fort Ann, 27 June 1918, *S. H. Burnham* s.n. (GH). **Ohio:** Lucas Co., Springfield Twp., Kitty Todd Preserve of TNC, South Piel Sand Barren, *J. K. Bissell, B. W. Danielson & J. Knoop* 1993:047 (MICH). **Vermont:** Addison Co., cliffs of Massalamoo Mt., Salisbury, 5 July 1901, *E. Brainerd* s.n. (GH); Bennington Co., Pownal, Mason Hill, 18 June 1901, *J. R. Churchill* s.n. (MO); Caledonia Co., Gibson Quarry, Blue Mt., Ryegate, *F. C. Seymour* 18911 (BRIT, DAO, MO); Orange Co., Palisades, Fairlee, *M. E. Mathias* 149 (MO, NY). **Wisconsin:** Brown Co., Big Suamico near shore of Green Bay, 22 July 1883, *J. H. Schuette* s.n. (F); Jackson Co., shore of Lee Lake at Millston, *A. M. Peterson* 374A (WIS); Juneau Co., about 5.2 mi. N of Mauston along Co. Rt. Q, *V. E. McNeilus* 87-846, 87-848 (MICH, MO, WIS); Marquette Co., Page Creek wetlands, N shore of Bright Lake, 2.7 mi. ESE of Packwaukee, *T. S. Cochran, S. Richter & P. West* 13216 (MICH, WIS); Sawyer Co., beach of pond 10 mi. E of Hayward, 22 June 1928, *L. Griscom* s.n. (GH); Waupac Co., quarry, Redgranite, 16 June 1960, *J. H. Zimmerman* s.n. (WIS).

3. *Carex missouriensis* P. Rothrock & Reznicek, sp. nov. TYPE: U.S.A. Missouri: Audrain Co., Possumwalk Rd.-Audrain Co. Rd. No. 963, ca. 0.8 mi. W of intersection with Rt. E or ca. 6.7 mi. E of the intersection of rts. 22 and 151 in Centralia, T51N, R10W, SE ¼ of the SE ¼ of the SW ¼ of the SW ¼ sec. 15, wet prairie remnant between two RR beds, 28 May 1998, *P. M. McKenzie* 1811 with *B. Jacobs* (holotype, MICH; isotypes, BH, BRCH, BRIT/SMU, BUT, Hb. Charles T. Bryson, DAO, F, GENT, GH, ILLS, ISC, K, KANU, KNK, MO, NEB, NY, OKL, OMA, TENN, US, WIS).

Carex straminea var. *meadii* F. Boott, Ill. Carex 3: 121. pl. 389. 1862. Syn. nov. TYPE: U.S.A. Illinois: *Mead* s.n. (lectotype, here designated, K, photo at MICH).

Caespitosae; culmi fertiles 45-110 cm alti; vaginae basales brunneae vel nigrae. Folia 3-5(-6); laminae 2.5-25 cm longae, 1.8-3.2(-4) mm latae; vaginae ca. 1-24 cm longae, laeves ventraliter herbaceae. Culmi vegetativi erecti, annui. Inflorescentiae (2-)2.5-5 cm longae, erectae, aliquando arctuateae, plus minusve congestae; spicae 3-8 gynaeandreae, ovoideae vel globosae, 8-14 × 4.5-9.5 mm, basi staminata 1-3.5 mm longa. Squamae pistillatae pallide brunneae, acuminatae vel aristatae, arista herba-

cea, albo-hyalina, ad 0.7 mm longis. Perigynia (4.6–)5–7.1 × 2.5–4 mm, ascendentia, corporibus late ellipticis vel ovatis, in rostrum serrulatum 1.7–2.6(–2.8) mm longum contracta. Achenium 1.6–2.2 × 1.2–1.6 mm, biconvexum. Stigmata 2. Antherae 3, 2.2–3.6 mm longae.

Caespitose in small to large clumps, with up to 100 culms from short, thick, woody rhizomes; fertile culms 45–110 cm tall, erect, trigonous, smooth except for finely scabrous angles just below inflorescence; bladeless basal sheaths blackened to pale purple-brown disintegrating into short, dark brown fibers. Leaves 3 to 5(6), on lower 1/6–2/5 of the culm; blades 2.5–25 cm long, 1.8–3.2(–4) mm wide, plicate, smooth or papillose adaxially, the margins and midrib smooth to antrorsely scabrous; leaf sheaths ca. 1–24 cm long, ± tightly enveloping culms, smooth, yellow-green, the intervenal areas sometimes pale and with scattered septae; the ventral surface with indistinct Y-shaped hyaline area reaching up to 8 mm below the orifice, its apex concave or truncate, extending 0–2 mm above the base of the blade; ligules 2–4 mm long, rounded, the free portion entire and up to 0.5 mm long. Vegetative culms annual, few, ca. 20–90 cm tall during fruiting season, leaves (6)8 to 14, the lower 3 or 4 leaves evenly spaced along the culm, the rest clustered apically. Inflorescences (2–)2.5–5 cm long, erect or occasionally arched or nodding, the spikes overlapping or congested (the lowest sometimes separated), the lowest spikes 4–10(–14) mm apart, spikes single at nodes, sessile; lowermost bracts 5–14 mm long, rarely aristate bristle-tipped, seldom exceeding the spike, sheathless, upper bracts much reduced; spikes 3 to 8, gynecandrous, 8–14 mm long, globose to ovoid or conic, bases rounded to acute, apices acute, obtuse, or rounded, pistillate portion 7–12 × 4.5–9.5 mm, ca. 20- to 55-flowered, staminate portion 1–3.5 × 1.8–3 mm, ca. 9- to 26-flowered. Pistillate scales 3.7–4.9(–5.6) × (1–)1.3–1.8 mm, reaching from the base to the middle of the perigynium beak, (1–)1.7–2.6 mm shorter than the perigynium, 2.4–3.1 times as long as wide, lanceolate or lance-ovate, concave proximally, acuminate, with a delicate, membranaceous, usually whitish-hyaline and curled or flexuous awn up to 0.7 mm long, pale yellowish brown or occasionally pale reddish brown tinged, with narrow yellow-brown or yellow-brown and green center and broad hyaline margins, 1-nerved or faintly 3-nerved, the midnerve not extending into the awn. Staminate scales 3–5 × 1–2 mm, ovate to lance-ovate, obtuse to acuminate, yellowish brown and sometimes pale reddish brown tinged, with narrow band and broad hyaline margins, 1-nerved or faintly 3-nerved. Perigynia glabrous, sessile, (4.6–)5–7.1 × (2.5–)3.1–4

mm, 1.4–2.3 times as long as wide, loosely ascending, flat or concavo-convex except over the achene, 0.5–0.7 mm thick, herbaceous, ± opaque over achene; bodies broadly elliptic to ovate, (2.4–)3–4.7 mm long, 0.9–1.3(–1.5) times as long as wide and (1.3–)1.4–2.1 times as long as beak, widest (1.2–)1.4–2.1 mm above base, broadly thin-winged with wings 0.6–1.1 mm wide, the margin finely serrulate except near base, rarely erose, scalloped, or with an irregular tooth in the shoulder area, abruptly contracted into a narrow beak, the area around the achene and beak base light green, yellow-brown, or pale reddish brown, wing margin greenish or pale brown, 0 to 3(5) nerves adaxially over achene, 0 to 8 nerves abaxially over achene and 1 or 2 nerves in winged margin; beaks 1.7–2.6(–2.8) mm long, strongly flattened and serrulate-margined to apex, the dorsal suture pale or reddish brown, the apex conspicuously bidentate with scabrous-margined teeth 0.1–0.6 mm long, distance from summit of achene to tip of beak 2.6–4.2 mm long. Achenes 1.6–2.2 × 1.2–1.6 mm, 1.2–1.7 times as long as wide, biconvex, elliptical to ± orbicular, pale to dark brown, short-stipitate at base, apiculum 0.4–1.1 mm long; style straight; stigmas 2. Anthers 3, 2.2–3.6 mm long. Chromosome number: $n = 23 \text{ II} + 1 \text{ III}$, $24 \text{ II} + 1 \text{ III}$, $24 \text{ II} + 2 \text{ III}$, 25 II , $25 \text{ II} + 1 \text{ III}$, 26 II , 27 II .

For a species of narrow geographic distribution and habitat range, the chromosome numbers for *Carex missouriensis* were remarkably variable (Table 1). Chromosomes ranged from $n = 23 \text{ II} + 1 \text{ III}$ to $n = 27 \text{ II}$, with more than half of the plants sampled having at least one trivalent in the chromosome complement. In spite of the wide range in chromosome numbers, both *C. opaca* and *C. shinersii* had distinctly higher numbers.

Carex missouriensis inhabits prairie swales, often on bottomlands. Many collections come from narrow remnant prairie communities extant along railroad right-of-ways. Despite this limitation, populations were frequent from central Illinois to northeastern Missouri, but extend to southeastern Kansas, southeastern Nebraska, and southern Iowa (Fig. 10). Efforts to find populations in extreme eastern Illinois were unsuccessful. A single historical collection exists from western Indiana. Field reconnaissance identified the likely location but habitat disturbance and/or competition with *Phalaris arundinacea* L. have probably extirpated the population.

Carex missouriensis is named for the fact that Missouri is the heart of the species range. The name *Carex meadii* is already occupied, so it was

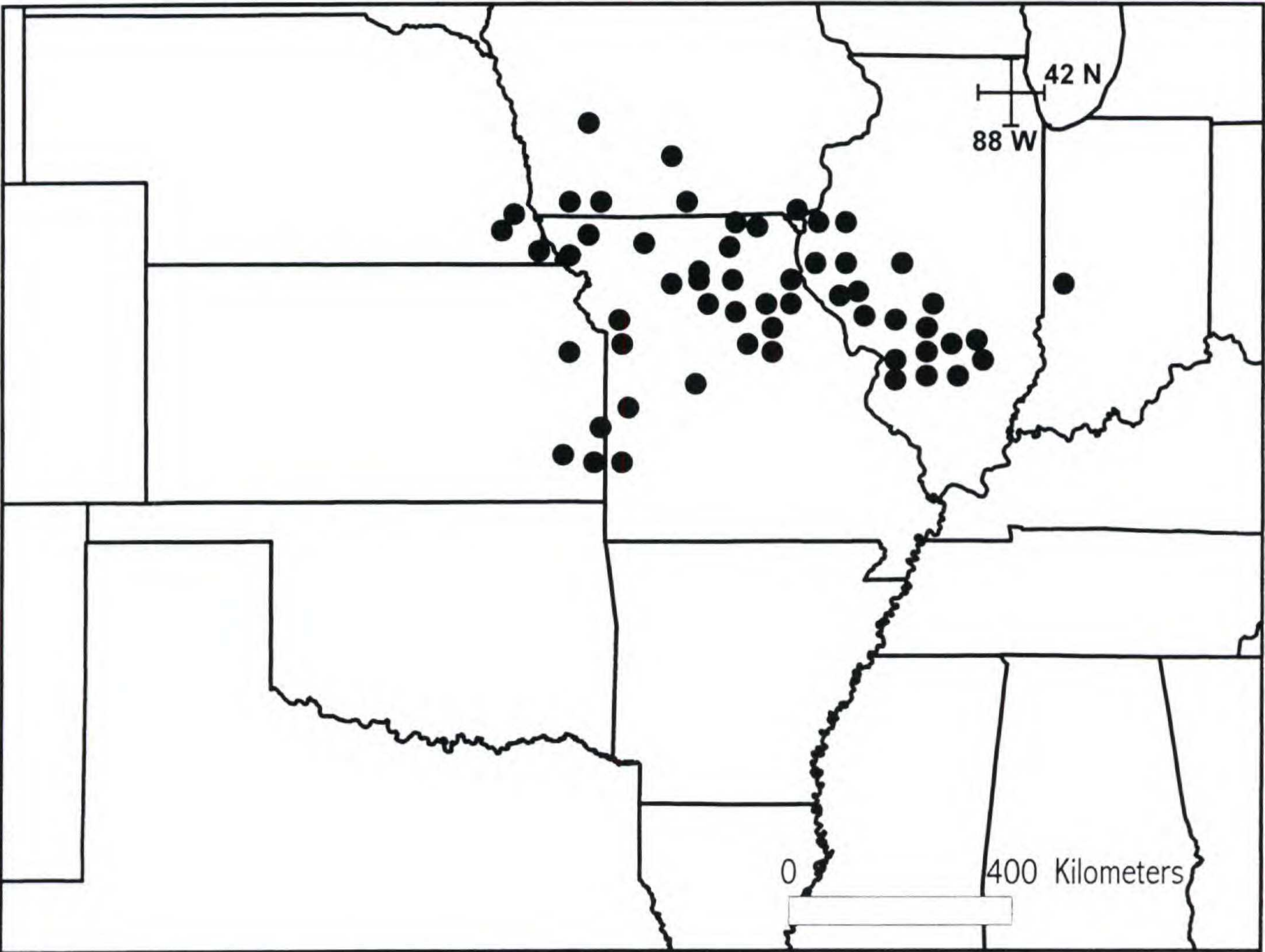


Figure 10. Geographical distribution of *Carex missouriensis*.

not possible to raise *C. straminea* var. *meadii* Boott to species rank. However, Boott (1862) first noted and illustrated the distinctive scales of this plant, commenting that “the long cuspidation of the squamae, with their broad, hyaline margins, give a peculiar aspect to this form.” Boott cited two syntypes for this variety: Illinois, *Dr. Short, Dr. Mead*. Both syntypes are extant in Boott’s herbarium (K), and we select the Mead specimen as lectotype because it was used for Boott’s illustration. The sheet in Boott’s herbarium had no data besides Illinois. A possible isolectotype with the additional data “Augusta, 1842” is in US, and additional possible isolectotypes with the data “Augusta, 9 May 1842” are in GH and F.

This species clearly has been a puzzle to Missouri botanists for a long time, as notes on herbarium sheets by D. Castaner and J. A. Steyermark, and annotations by F. J. Hermann clearly indicated the unusual morphology of some Missouri specimens they called *C. bicknellii*. Yatskievych (1999) also clearly outlined the three elements of the *C. bicknellii* complex in Missouri. The Menard County record for *C. straminea* in Illinois (Mohlenbrock, 1999) is based on a specimen of *C. missouriensis*.

Putative hybrids with other species: none known.

Paratypes. U.S.A. **Illinois:** Adams Co., 1 mi. NE of La Prairie, *R. A. Evers* 63662 (ILLS); Bond Co., SW of Mulberry Grove, *R. A. Evers* 23885 (ILLS); Brown Co., along RR, W of Timewell, *R. A. Evers* 108195 (ILLS); Clinton Co., ca. 0.25 mi. E of 800E, ca. 0.75 mi. W of Breese, *P. E. Rothrock* 3569 (MICH); Effingham Co., S of Montrose, *R. A. Evers* 16440, 16444 (ILLS); Fayette Co., W of St. Elmo, *R. A. Evers* 10125 (ILLS); along RR, N of Ramsey, *R. A. Evers* 68813 (ILLS); Greene Co., 5 mi. N of Eldred, *R. A. Evers* 33270 (ILLS); Hancock Co., along Wabash RR, Denver, *F. C. Gates* 8823 (F); Madison Co., W side of Ill. 111, N of Poag Rd., *E. F. Ulaszek* 1337 (ILLS); Marion Co., along RR, NE of Kinmundy, *R. A. Evers* 112926A (ILLS); McDonough Co., along RR, E of Tennessee, *R. A. Evers* 72803 (ILLS); Menard Co., Athens, June 1870, *E. Hall s.n.* (F, GH, NY); Montgomery Co., 7.9 mi. NE of the middle of Irving, *A. A. Reznicek et al.* 10207 (F, GH, ILLS, KANU, MICH, MO, NY); Pike Co., along GM&O RR, W of Pleasant Hill, *R. A. Evers* 107822 (ILLS); St. Clair Co., W of Caseyville, *J. O Neill* 3179 (ILLS); Scott Co., SE side of State Rte. 267, 0.3 mi. SW of Scott-Morgan Co. line, ca. 1.5 mi. NE of Manchester, *A. A. Reznicek et al.* 10219 (ILLS, MICH, MO, WIS). **Indiana:** Parke Co., 5 mi. NE of Clinton, *R. M. Kriebel* 10198 (PUL). **Iowa:** Lee Co., Keokuk, 1 June 1897, *B. Shimek s.n.* (ISC); Page Co., along Waubash Trace railway in Sec. 16, Colfax Twp., *B. Wilson* 2671 (OMA); Warren Co., Middle River, 31 May 1919, *L. H. Pammel s.n.* (ISC).

Kansas: Bourbon Co., 1/2 mi. S of Hammond, *D. Castaner* 3479 (MO); Crawford Co., Arma, *A. A. Reznicek et al.* 9821 (BRCH, KANU, KNK, MICH); Douglas Co., 3 mi. E of Lawrence, *L. J. Harms* 1258 (GH, KANU, NY); Johnson Co., 2 mi. W Clearview City, S side jct. of KS Hwy. 10 and Evening Star Road, *C. Morse* 4561A (KANU, MICH); Linn Co., floodplain of Marais de Cygne River, 2 mi. W, 1.5 mi. N of La Cygne, *L. J. Harms & O. A. Kolstad* 2017 (KANU); Neosho Co., US Hwy. 59 ca. 3 mi. N of Parsons, 0.4 mi. N of Neosho Co. line, *A. A. Reznicek et al.* 9833 (BRCH, Hb. C. T. Bryson, KANU, KNK, MICH). **Missouri:** Adair Co., 0.2 mi. SE of jct. with Rte. KK in Millard, *A. A. & S. A. Reznicek* 9859 (BRCH, Hb. C. T. Bryson, FTG, KNK, MICH, VPI); Audrain Co., low area between Hwy. 22 and Boone Co. Line Road, *D. Castaner* 7570 (MICH, MO, WIS); 1.5 mi. E of jct. with Rte. V to Sturgeon, *A. A. & S. A. Reznicek* 9864 (BRCH, FTG, MICH, MO); Barton Co., along Pettis Creek, 4 mi. S of Lamar, *E. J. Palmer* 65082 (KANU, WIS); Benton Co., 2.25 mi. S of Pettis Co., 5 mi. E of 65, 3.5 mi. W of Lake Creek (town), *D. Castaner* 6293 (MO); Boone Co., ca. 5 mi. NNW of Centralia, *A. A. & S. A. Reznicek* 9867 (FTG, MICH, MO); 2 mi. E of Sturgeon, *D. Castaner* 7562 (MO); Callaway Co., Tucker Prairie, ca. 2.5 mi. WNW of jct. US 54 and I-70 in Kingdom City, *A. A. Reznicek et al.* 10192 (F, KNK, MICH, MO, WIS); Clay Co., N of Kansas City along Bedford at Quebec Street along RR, *D. Castaner* 10357 (MO); Gentry Co., W of Stanberry on Hwy. 136, *D. Castaner with G. Maupin* 5678 (MO); Harrison Co., E of 00 (Bethany), S of 136 at Dept. of Conservation prairie, *D. Castaner et al.* 5711 (MO); Holt Co., Squaw Creek National Wildlife Refuge, *P. M. McKenzie* 1378 (MICH, MO); Jackson Co., Grain Valley, *B. F. Bush* 7000 (F, GH, MO); Linn Co., 4 mi. S of North Salem, *J. A. Steyermark* 65647 (F); Livingston Co., 7 mi. S of Trenton, *B. Summers with K. Kramer* 4346 (MO); Macon Co., 0.4 mi. W of the Chariton River bridge, ca. 12 mi. W of Macon, *A. A. & S. A. Reznicek* 9856 (BRCH, Hb. C. T. Bryson, DAO, FTG, GENT, KNK, MICH, MO, TRTE, VDB, VPI); Marion Co., 1.7 mi. E of Rte. V jct. at Hunnewell, *A. A. & S. A. Reznicek* 9873 (BRCH, Hb. C. T. Bryson, FTG, KNK, MICH, MO); Monroe Co., 0.6 mi. N of Monroe Co. line, ca. 10 mi. N of Centralia, *A. A. & S. A. Reznicek* 9869 (BRCH, MICH, MO); Nodaway Co., ca. 4.0 km N of Pickering on E side of St. Hwy. 148, *G. Yatskiyevych with B. Summers* 93-178 (MICH, MO); Ralls Co., 2.2 mi. W of jct. Rte. J to Perry, ca. 2 mi. NE of Monroe City, *A. A. & S. A. Reznicek* 9876 (BRCH, Hb. C. T. Bryson, FTG, KNK, MICH, MO); Randolph Co., US Hwy. 63, 0.4 mi. S of jct. with Rte. J in Jacksonville, *A. A. & S. A. Reznicek* 9863 (BRCH, Hb. C. T. Bryson, KNK, MICH, MO); Schuyler Co., E side of RR tracks along SR 202, 1 mi. N of jct. with CR AA at Glenwood, *P. E. Rothrock* 3558 (MICH, MO); Shelby Co., US Hwy. 36, 2.4 mi. WNW of jct. with Rts. T and PP at Lakenan, *A. A. & S. A. Reznicek* 9871 (BRCH, FTG, KNK, MICH, MO). **Nebraska:** Johnson Co., Middle Branch Big Nemaha River, 2 mi. S, 1.4 mi. E of St. Mary, *S. Rolfsmeier et al.* 8689 (NEB); Otoe Co., near Palmyra, *W. Kiener* 30008 (NEB); Richardson Co., right-of-way of CB&Q RR about 1 mi. SE of Salem depot, *P. Shildneck* C-6474 (ILLS, KANU, MOR, NEB).

4. *Carex opaca* (F. J. Hermann) P. Rothrock & Reznicek, comb. et stat. nov. Basionym: *Carex bicknellii* var. *opaca* F. J. Hermann, Sida 5: 49. 1972. TYPE: U.S.A. Arkansas: Prairie Co., river terraces, never plowed, rice region, Hazen, elev. 215', 10 May 1969, *D. Demaree* 60141 (holotype, US; isotypes, BRIT, MO).

Caespitose in dense, large clumps of up to 200 culms from short, thick, woody rhizomes; fertile culms 50–115 cm tall, erect, trigonous, finely scabrous-angled below inflorescence; bladeless basal sheaths medium to dark brown, disintegrating into short, dark brown fibers. Leaves 3 to 6, on the lower 1/4–2/5(–1/2) of the culm; blades 3.5–40 cm long, 1.5–4.6 mm wide, plicate, glabrous, the margins, midrib, and sometimes the adaxial leaf surface antrorsely scabrous distally; leaf sheaths ca. 3–12 cm long, tightly enveloping culms, smooth, green, larger sheaths with the intervenal areas pale whitish green with scattered, \pm horizontal green septae on the upper portion; the inner band of sheaths glabrous, green with a whitish-hyaline band near the apex, the apex concave to truncate, \pm equaling the base of the blade, whitish-hyaline, sometimes brown-tinged; ligules 1.5–5.4 mm long, rounded to obtuse, the free portion entire and up to 0.8 mm long. Vegetative culms annual, few, fully developed only after perigynia are largely shed, ca. 35–80 cm tall with ca. 6 to 14 leaves mostly clustered near the summit of the culm. Inflorescences 2.4–5.5(–6.4) cm long, erect to slightly arching, the spikes overlapping or the lowermost separate, the lowest spikes 4–13(–18) mm apart, spikes single at nodes, sessile; lowermost bracts scalelike, 0.5–1.5 cm long, inconspicuous, sheathless, upper bracts much reduced; spikes 4 to 8(10), gynecandrous, ovoid with rounded to tapered bases, 10–22 mm long, pistillate portion 9–14 \times 5.5–12 mm, ca. 15- to 40-flowered, staminate portion 1–8(–14) \times 1.5–2.6 mm, ca. 7- to 18-flowered. Pistillate scales (3.6–) 3.9–5 \times 1.3–1.9 mm, not or barely reaching the base of the beak, usually 1.5–2.6 mm shorter than the perigynia, (2.2–) 2.4–3.2(–3.4) times as long as wide, lanceolate to narrowly ovate, obtuse to acute, rarely the uppermost acuminate, pale brown with narrow yellow-green to brown center and narrow hyaline margins, 1-nerved, the nerve reaching to the apex. Staminate scales 3.6–5.2 \times 1.5–2.4 mm, narrowly ovate to narrowly elliptic, obtuse to acute, pale brown with narrow hyaline margins, 1-nerved. Perigynia glabrous, sessile, (5–) 5.8–7.1 \times (3.1–) 3.3–4.6(–4.8) mm, 1.3–1.9 times as long as wide, \pm appressed and often strongly concave, 0.5–0.7 mm thick, herbaceous, opaque over achene; bodies broadly ovate, broadly elliptic, or orbicular (3.2–) 3.9–5 mm long, (0.8–) 1–1.4 times as long as wide, 1.9–3 times as long as the beak, and widest (1.4–) 1.8–2.8 mm above base, broadly thin-winged with wings 0.9–1.6 mm wide, finely serrulate-margined above the middle, contracted into a beak, yellowish green to brown with paler margins, \pm clearly 3- to 7-nerved adaxially over the achene, 8- to 12-nerved

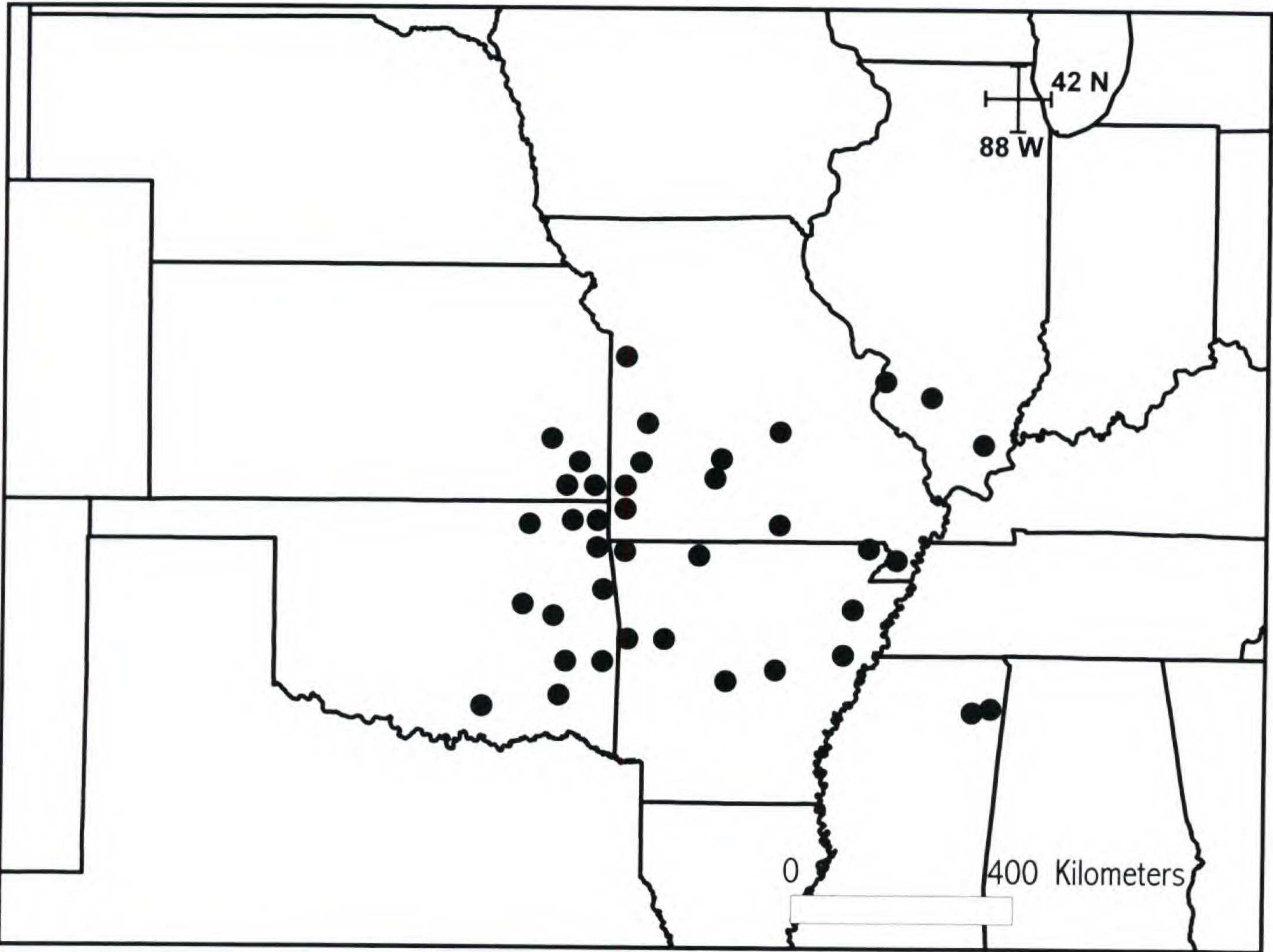


Figure 11. Geographical distribution of *Carex opaca*.

abaxially over the achene and 2- to 5-nerved in the wings; beaks (1.2–)1.5–2.3 mm long, strongly flattened and serrulate-margined to apex, the apex bidentate with scabrous-margined teeth 0.2–0.5 mm long, distance from summit of achene to tip of beak 2.8–4 mm. Achenes 1.8–2.4 × 1.3–1.9 mm, 1.1–1.6 times as long as wide, biconvex, broadly ovate to oblong, pale brown to brown, short-stipitate at base, apiculum 0.5–1.1 mm long; style straight; stigmas 2. Anthers 3, 2.2–3.4 mm long. Chromosome number: $n = 32 \text{ II} + 1 \text{ III}, 33 \text{ II}, 34 \text{ II}$.

Carex opaca had chromosome numbers ranging from $n = 32 \text{ II} + 1 \text{ III}$ to $n = 34 \text{ II}$ (Table 1). This range is higher than that of *C. shinnersii* and very much higher than that of *C. missouriensis*, thus providing strong cytogenetic support for recognizing *C. opaca* as a distinct species.

Carex opaca occupies wet areas in regions where the presettlement vegetation included prairie and savanna. The type locality is described by Demaree as low areas in “rice prairies.” *Carex opaca* is still present in moist sites in extant prairies and savannas, but compared to *C. missouriensis*, it tolerates or is quick to invade disturbance sites and may be associated with poorly drained areas along highway

right-of-ways. In spite of this tolerance of disturbance, the geographical distribution of *C. opaca* is surprisingly narrow. When first described as *Carex bicknellii* var. *opaca*, it was thought to be an Arkansas endemic. Later, it was reported for Missouri and Oklahoma by Castaner (1989). The species center of distribution surrounds the Ozark Mountain system (Fig. 11). Somewhat disjunct populations occur in southernmost Illinois. Roadside occurrences in Mississippi and perhaps other roadside occurrences at the periphery of the species range may be recent introductions.

Putative hybrids with other species: none known.

Representative specimens. U.S.A. **Arkansas:** Benton Co., S side I-412, 0.2 mi. W of Ark. Hwy. 16B jct., E outskirts of Siloam Springs, A. A. Reznicek et al. 9788 (BRCH, MICH, UARK); Boone Co., S of Harrison, P. E. Hyatt 3857.05 (MICH); Clay Co., 4.5 mi. E of Ark. Hwy. 135 on US Hwy. 62, P. E. Hyatt 4380.11 (MICH); Logan Co., W side Ark. Hwy. 23, 5 mi. NE of Franklin Co. line, 0.8 mi. SW of Caulksville, A. A. Reznicek et al. 9387 (Hb. C. T. Bryson, MICH, TAES, UARK); Lonoke Co., NE corner of interchange I-40 and Ark. Hwy. 13, just N of Carlisle, A. A. Reznicek et al. 9265 (Hb. C. T. Bryson, FTG, GENT, KNK, MICH, TAES, UARK, VDB, VPI); Poinsett Co., Waldenberg P.O. property, P. E. Hyatt 4350.56 (MICH); Prairie Co., Ulm, D. Demaree 14915 (BRIT, ISC,

MICH, MO, OS, WIS); Saline Co., low, moist bottoms, Benton, *D. Demaree* 22969 (GH, IND); St. Francis Co., Rock Island (So. Pacific) RR Prairie, N side of US 70, *A. B. Pittman* 303 (MICH); Sebastian Co., 5.8 mi. W of Bloomer, *L. H. Shinnars* 19831 (BRIT); county unknown, low ground, NW Ark., May 1884, *F. L. Harvey* 10, 14 (F, GH, US). **Illinois:** St. Clair Co., E of Fayetteville, *R. A. Evers* 73553 (ILLS); Saline Co., Harrisburg, 0.2 mi. N of US Rt. 45, 0.3 mi. SW of Middle Fork of the Saline River, *S. R. Hill* 32379 with *K. Haefner* (ILLS, MICH); Washington Co., railroad trackway at Venedy Station, *R. A. Evers* 33943 (ILLS). **Kansas:** Cherokee Co., W side US Hwy. 69, ca. 6 mi. S of Pittsburg, 1.1 mi. S of Cherokee/Crawford Co. line, *A. A. Reznicek et al.* 9824 (BRCH, Hb. C. T. Bryson, KANU, MICH); Crawford Co., 3 mi. E, 3 mi. S of Pittsburg, *O. A. Kolstad & L. J. Harms* 2264 (GH, KANU); Labette Co., N side of US Hwy. 160, 1.3 mi. E of Neosho River bridge, ca. 10 mi. E of Parsons, *A. A. Reznicek et al.* 9830 (BRCH, KANU, MICH); Neosho Co., K57, W edge of St. Paul, *O. A. Kolstad & L. J. Harms* 2282 (BRIT, KANU); Neosho County State Lake, *R. L. McGregor* 38183 (KANU). **Mississippi:** Itawamba Co., N of Dorsey, SW jct. of hwy. 78 and Fawn Grove/Dorsey exit, *C. T. Bryson* 13802 (Hb. C. T. Bryson, MICH); Lee Co., E of Tupelo, jct. hwy. US 78 and Auburn Rd., *C. T. Bryson* 12400 (Hb. C. T. Bryson, MICH). **Missouri:** Barton Co., Cook Meadow, 2 mi. NW of Golden City on S side of Co. Hwy. U, *G. Yatskievych et al.* 94-119 (MO); Howell Co., Warden Prairie, ca. 4 mi. SW of West Plains, ca. 1/2 mi. S of jct. w/ US 160, *G. Yatskievych et al.* 92-192 (MO); Jasper Co., Wah-Sha-She Prairie Conservation Area, ca. 2 mi. N of Ashbury, *A. A. Reznicek et al.* 9803 (BRCH, Hb. C. T. Bryson, KNK, MICH); Laclede Co., 2 1/2 mi. N of Phillipsburg, *B. Summers* 4434 (MO); Newton Co., along creek, Seneca, *E. J. Palmer* 65452 (GA); Phelps Co., 10 mi. SE of Rolla, 2 mi. SW of Elk Prairie, *J. A. Steyermark* 71641 (F, MO); St. Clair Co., near Taberville Prairie, 7 June 1977, *A. Christ s.n.* (MO); Stoddard Co., S side of US Hwy. 60, 1.4 mi. W of jct. with County Rd. TT at Dudley, *A. A. Reznicek et al.* 9421 (Hb. C. T. Bryson, KNK, MICH, MO, TAES, VDB); Vernon Co., N side of MO Hwy. 54, 1.1 mi. E of jct. MO Hwy. 43, ca. 3 mi. W of Nevada, *A. A. Reznicek et al.* 9820 (BRCH, Hb. C. T. Bryson, FTG, KNK, MICH, MO, VPI); Webster Co., S side of Hwy. US 60 along the St. Louis-San Francisco RR, *A. E. Brant & R. E. Gereau* 556 (SIU). **Oklahoma:** Adair Co., 1 mi. S and 5 mi. W of Watts, *U. T. Waterfall* 7013 (BRIT); Craig Co., US 66, 3.3 mi. W of Delaware Co. line, *M. Huft & M. Goodman* 1103 (OKL); Delaware Co., 6 mi. E of Hwy. 10 on Hwy. 20 from Jay, *D. Castaner* 7470 (MICH, MO, WIS); Johnston Co., 0.4 mi. E on OK 7 from its jct. with the Blue River, E of Reagan, *S. & G. Jones* 10230 (MICH); Latimer Co., N side US Hwy. 270, 3.2 mi. E of center of Wilberton, 4.1 mi. E of jct. Hwy. 2S and US Hwy. 270, *A. A. Reznicek et al.* 9341 (Hb. C. T. Bryson, MICH, TAES); Le Flore Co., W side Okla. Hwy. 120, 3.7 mi. W of Cameron, *A. A. Reznicek et al.* 9330 (Hb. C. T. Bryson, KNK, MICH, TAES); McIntosh Co., 1/2 mi. N of Checotah, *D. Castaner* 1200 (MO); Okmulgee Co., Deep Fork Unit, Eufaula WMA, *B. Hoagland & E. Wagoner* DF0013 (OKL); Ottawa Co., 1/2 mi. NE of Quapaw on US 66, *C. S. Wallis* 7273 (BRIT, KANU, NCU, OKL); Pushmataha Co., E side Okla. Hwy. 2, 3.5 mi. S of Latimer Co. line, 0.5 mi. N of jct. with US 271N, ca. 19 mi. S of Wilberton, *A. A. Reznicek et al.* 9344 (Hb. C. T. Bryson, MICH, TAES); Washington Co., about 1/4 mi. S of Copan dam on Caney River, *J. & C. Taylor* 33290 (BRIT).

5. *Carex shinnarsii* P. Rothrock & Reznicek, sp. nov. TYPE: U.S.A. Texas: Delta Co., W side Texas Hwy. 19, 1.9 mi. S of jct. with Texas Hwy. 24, ca. 7 mi. NE of Cooper, 33°25'51"N, 95°36'11"W, wet, seasonally flooded grassy ditch, abundant in large, dense clumps around the edges of the lowest and wettest depressions in the ditch that were essentially free of vegetation due to flooding, 3 May 1997, *A. A. Reznicek* 10367 with *S. D. Jones & S. A. Reznicek* (holotype, MICH; isotypes, BH, BRCH, BRIT/SMU, Hb. Charles T. Bryson, F, GENT, GH, K, KANU, KNK, KSC, MO, NY, OKL, TENN, TEX, UARK, US, VDB, WIS).

Caespitosae; culmi fertiles 40–110 cm alti; vaginae basales brunneae. Folia 4–6; laminae 2.5–35 cm longae, 1.8–4.2 mm latae; vaginae ca. 2–11 cm longae, ventraliter herbaceae, laeves. Culmi vegetativi erecti, annui. Inflorescentiae 2.8–5.9 cm longae, erectae, plus minusve congestae; spicae (3–)4–7(–11) gynaeandreae, ovoideae, 9.5–20.5 × 8–11.5 mm, basi staminata (1.5–)2–9.5 mm longa. Squamae pistillatae pallide brunneae, acuminatae. Perigynia (4.5–)4.8–6.1(–6.3) × 2.5–3.8 mm, ascendunt, corporibus ellipticis, ovatis, vel rotundis, in rostrum serulatum 1.4–2.2 mm longum contracta. Achenium 1.8–2.4 × 1.3–1.7 mm, biconvexum. Stigmata 2. Antherae 3, 2.4–3.4 mm longae.

Caespitose in dense, large clumps of up to 200 culms from short, thick, woody rhizomes; fertile culms 40–110 cm tall, erect, trigonous, smooth to finely scabrous-angled below inflorescence; bladeless basal sheaths medium to dark brown, disintegrating into short, dark brown fibers. Leaves 4 to 6, on the lower (1/4–)3/10–1/2 of the culm; blades 2.5–35 cm long, 1.8–4.2 mm wide, plicate, glabrous, the margins and midrib antrorsely scabrous distally; leaf sheaths ca. 2–11 cm long, tightly enveloping culms, smooth, green, larger sheaths with the intervenal areas pale whitish green with scattered, ± horizontal green septae; the inner band of sheaths glabrous, green with a broad whitish-hyaline band, the apex concave to truncate, equaling to extending 2 mm above the base of the blade, whitish-hyaline, sometimes brown-tinged; ligules 1.8–4.8 mm long, rounded to obtuse, the free portion entire and up to 0.6 mm long. Vegetative culms annual, few, fully developed only after perigynia are largely shed, ca. 30–90 cm long with ca. 9 to 17 leaves mostly clustered near the summit of the culm. Inflorescences 2.8–5.9 cm long, erect to slightly arching, the spikes overlapping to somewhat distant, the lowest spikes 3.5–12(–17) mm apart, spikes single at nodes, sessile, lowermost bracts scalelike to setaceous with an expanded base, 0.5–1.5(–3.5) cm long, inconspicuous, sheathless, upper bracts much reduced; spikes (3–) 4–7(–

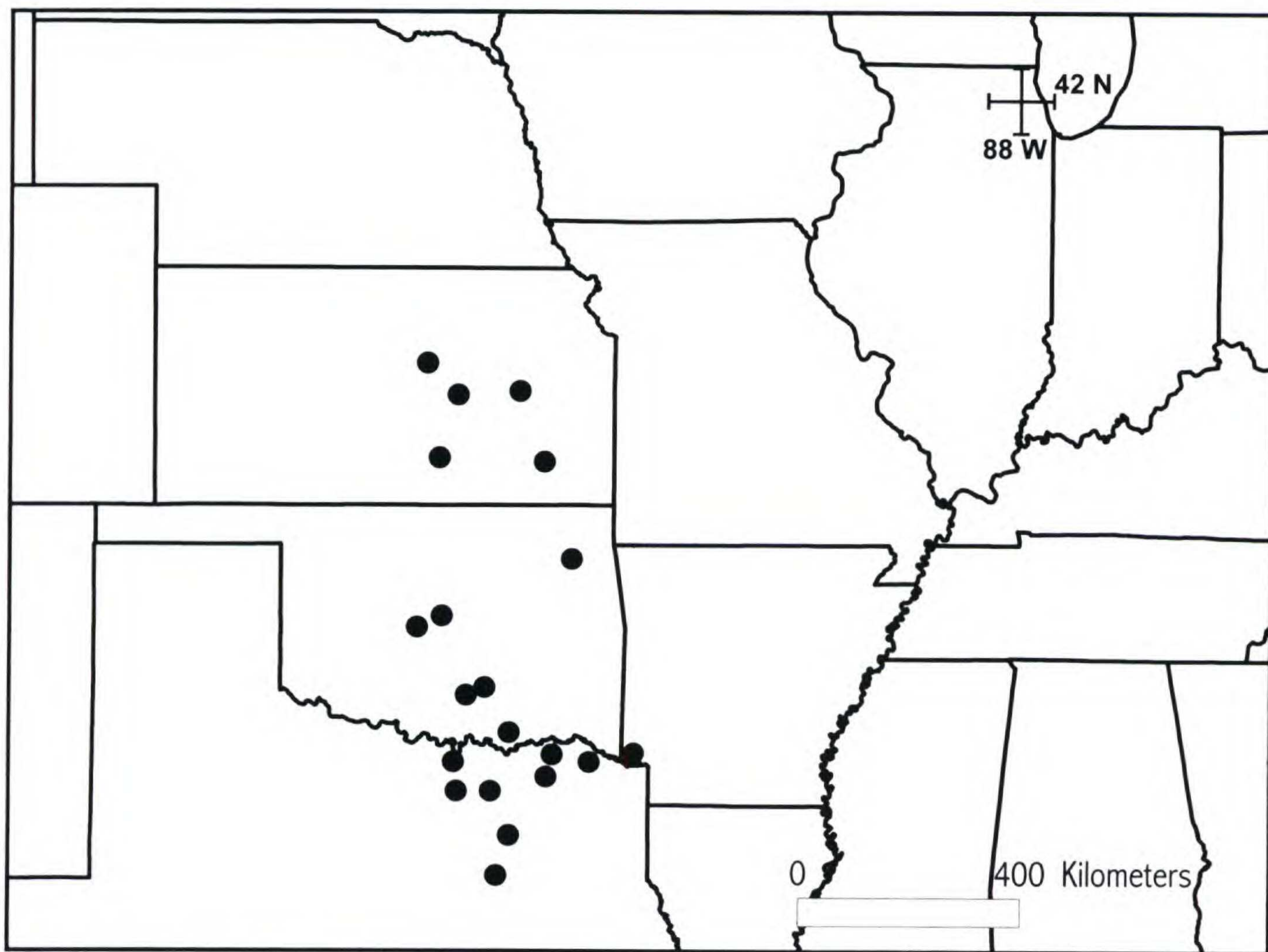


Figure 12. Geographical distribution of *Carex shinnnersii*.

11), gynecandrous, ovoid with \pm tapered bases, 9.5–20.5 mm long, pistillate portion 7–12 \times 8–11.5 mm, ca. 18- to 45-flowered, staminate portion (1.5–)2–9.5 \times 1.2–2 mm, ca. 12- to 20-flowered. Pistillate scales (3.7–)4–5.2 \times 1.1–1.6(–1.8) mm wide, reaching the base to the middle of the beak, (0.4–)0.6–1.4(–1.6) mm shorter than the perigynium, (2.6–)2.9–3.7(–4.2) times as long as wide, lanceolate, acuminate, pale brown with narrow yellow-green to brown center and narrow hyaline margins, 1-nerved, the nerve extending to the scale apex. Staminate scales 3.9–5.6 \times 1.2–1.8 mm, narrowly ovate to narrowly elliptic, acute to acuminate, pale brown with hyaline margins, 1-nerved. Perigynia (4.5–)4.8–6.1(–6.3) \times 2.5–3.8 mm, 1.4–2.3 times as long as wide, glabrous, sessile, ascending, planoconvex, 0.5–0.7 mm thick, herbaceous, opaque over achene; bodies ovate, elliptic, or \pm orbicular, (2.8–)3.3–4.4 mm long, 1–1.6 times as long as wide, 1.8–2.6(–3) times as long as the beak, and widest 1.6–2.9 mm above base, broadly thin-winged with wings 0.5–1.3 mm wide, finely serrulate-margined except near base, contracted into a beak, yellowish green to brown with paler margins, faintly (0)2- to 8-nerved adaxially over the achene,

7- to 11-nerved abaxially over the achene and 1- to 4-nerved in the wings; beaks 1.4–2.2 mm long, strongly flattened and serrulate-margined to apex, the apex bidentate with scabrous-margined teeth 0.1–0.5 mm long, distance from summit of achene to tip of beak (2–)2.3–3.3 mm. Achenes 1.8–2.4 \times 1.3–1.7 mm, (1.2–)1.4–1.6 times as long as wide, biconvex, ovate to elliptic, pale brown to brown, short-stipitate at base, apiculum 0.4–0.9 mm long; style straight; stigmas 2. Anthers 3, 2.4–3.4 mm long. Chromosome number: $n = 29 \text{ II} + 1 \text{ III}, 30 \text{ II}$.

Carex shinnnersii appears to range along a narrow band that extends from northeastern Texas to south-central Kansas (Fig. 12). It occupies moist to wet depressions in prairies, wet habitats along stream bottoms, in either open or lightly shaded settings, as well as similar man-made habitats such as ditches, shores of ponds and reservoirs, etc.

The epithet *shinnnersii* honors Lloyd H. Shinnners, keen and perceptive student of the Texas flora. Shinnners first recognized this species as different from anything else known from Texas, outlined the differences in brief notes on herbarium sheets, and reported it as *Carex bicknellii* (Shinnners, 1958).

At its large and small extremes, *Carex shinnensis* is similar to *C. opaca* and *C. brevior*, respectively, and can be difficult to distinguish, especially in poorer herbarium specimens, where the diagnostic pistillate scale apices can be mostly tattered or broken.

A site in Kaufman County, Texas, supported a population of *Carex shinnensis* growing with *C. brevior* and *C. tetrastachya* in the vicinity. In this setting, plants assignable to *C. shinnensis* had two possible chromosomal conditions. The collection Reznicek 10347 displayed normal meiotic condition and had $n = 30$ II (Table 1). Two plants (from the population represented by Reznicek 10346 (BRCH, BRIT, MICH, MO)) had disturbed meiotic pairing that we interpret as $n = 18$ II + 1 IV + 4 III. Although meiosis is irregular, their achenes appear fertile, becoming plump and starch filled. It is possible that these individuals are a hybridization product with *C. brevior*. This conclusion is supported by the number of chromosome components being intermediate in number between local *C. brevior* (with variable numbers: $n = 24$ II, 24 II + 1 IV, and 26 II; Rothrock & Reznicek, 1998) and typical *C. shinnensis*. Furthermore, perigynia were at the low end of the size range characteristic of *C. shinnensis* and the pistillate scales were less acuminate than seen in Reznicek 10347. None of these observations support hybridization with *C. tetrastachya*.

Paratypes. U.S.A. **Arkansas:** Little River Co., Foreman, 5 mi. S on Ark. Hwy. 41, extreme NW/4 of Sec. 14, T13S, R32W, P. E. Hyatt 7441 (MICH, UARK), 7442 (MICH, MO). **Kansas:** Chase Co., 2.0 mi. E Saffordville on US 50, NW corner of jct. 100 Rd. and Hwy. 50, C. A. Morse 3449 & D. S. Baker (DAO, F, GH, K, KANU, KSC, MICH, MO, NY, US, WIN); Lyon Co., 3.05 mi. E Saffordville on US Hwy. 50, C. A. Morse 3447 & D. S. Baker (BRIT, Hb. C. T. Bryson, KANU, KSC, MICH, MO, OKLA); Marion Co., 3.1 mi. N, 3.0 mi. E Hillsboro, W side of Marion Reservoir, C. A. Morse 3450 & D. S. Baker (KANU, MICH, MO, NEB, OKL); Saline Co., 1 mi. W of Gypsum, R. E. Brooks 17138 (KANU, GA); Sedgwick Co., ¼ mi. NE of Viola, S. Stephens 84776 (KANU); Wilson Co., 1 mi. S, 0.5 mi. E of Buffalo, R. L. McGregor 38265 (KANU). **Oklahoma:** Bryan Co., Blue River bridge on #69 N of Armstrong, D. Castaner 1548 (BRIT); Garfield Co., 1½ mi. S of Covington, S. Stephens 76721 (KANU); Mays Co., W side Okla. Hwy. 69, 5.4 mi. N of Adair (at Hwy. 28 Jct.), A. A. Reznicek 9764 et al. (BRCH, MICH, OKL); Murray Co., E of Breezy Point, F. L. Johnson et al. 30 (OKL); Oklahoma Co., 3½ mi. N of Wheatland, U. T. Waterfall 3639 (OKL); Pontotoc Co., Pontotoc Ridge Preserve (Smith Ranch), Sec. 32, T1N, R7E, P. Folley 1197 (OKL). **Texas:** Collin Co., 3/7 mi. E of Farmersville, L. H. Shinnens 14319 (BRIT); Cooke Co., ca. 2 mi. NE of St. Jo on FM 2382 at the Cooke-Montague Co. line on S side of FM 2382, E. L. Bridges & K. Kindscher 13661 (MICH); Delta Co., 0.1 of a mile S on FR 1529 from its jct. with

Hwy. 154, S. & G. Jones 2887 with T. Powell (MICH); Denton Co., 10 mi. N of Denton, V. L. Cory 57340 (BRIT); Kaufman Co., NE side of Co. Rd. 233 (Colquitt Rd.), 0.7 mi. NW of jct. with FR 1392, ca. 4 mi. NW of Terrell, A. A. Reznicek 10347 et al. (BRCH, BRIT, F, GH, KANU, KNK, MICH, MIN, MO, NY, OKL, TEX, US, VPI); Lamar Co., 5.2 mi. N on FR 1184 from its jct. with the extension of FR 1184 at Auds Creek, S. G. Jones 2882 & T. Powell (MICH); Navarro Co., Chambers Creek bottoms, 4½ mi. N of Corsicana, V. L. Cory 51530 (BRIT, MICH).

Acknowledgments. We are grateful to the curators of all the herbaria who so kindly lent us material or accommodated our visits. We also thank the many people who accompanied us in the field during our studies of this group, and often helped us with finding localities in their home states or collecting more material for us, including Allison Cusick, Mike Homoya, Phil Hyatt, Brad Jacobs, Stanley and Gretchen Jones, Doug Ladd, Paul McKenzie, as well as George Yatskievych. Caleb Morse very kindly collected members of this complex for us in Kansas, and Paul McKenzie and Brad Jacobs collected the type of *Carex missouriensis* for us. Stuart Hay very kindly helped us track down, through the Montréal Botanical garden records, the identities of the plants used by N. Tanaka in his chromosome number papers. David Simpson helped greatly by searching for Boott types at K. Bev Walters took the SEM photo for Figure 1 and Susan Reznicek prepared Figure 3. We are also grateful to Paul McKenzie and George Yatskievych for their thorough and very helpful reviews of our manuscript. We could not have finished this project without their help.

Literature Cited

- Boott, F. 1862. Illustrations of the Genus *Carex*. Part III. William Pamplin, London, pp. 105–126, pl. 311–411.
- Castaner, D. 1989. Missouri *Carex* notes 4. *Carex bicknellii* var. *opaca* in Missouri. *Missouriensis* 10: 13–15.
- Cooperrider, T. S. & J. H. Morrison. 1967. Lactic-acetic-orcin as a chromosome stain. *Michigan Bot.* 6: 176–178.
- Farwell, O. A. 1923 [1924]. Notes on the Michigan flora Part V. Pap. Michigan Acad. Sci. 2: 11–46.
- Fernald, M. L. 1902. The northeastern *Carices* of the section *Hyparrhenae*. *Proc. Amer. Acad. Arts* 37: 447–495.
- Gleason, H. A. 1952. The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada. New York Botanical Garden, Bronx, 3 vols.
- & A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada, 2nd ed. New York Botanical Garden, Bronx.
- Jones, S. D. & A. A. Reznicek. 1991. *Carex bicknellii*, “Bicknell’s sedge” (Cyperaceae): New to Texas, with a key to Texas species of section *Ovales*. *Phytologia* 70: 115–118.
- Hermann, F. J. 1972. A new variety of *Carex bicknellii* from Arkansas. *Sida* 5: 49.

- Hill, S. R. & C. N. Horn. 1997. Additions to the flora of South Carolina. *Castanea* 62: 194–208.
- Hyatt, P. E. 1998. Arkansas *Carex* (Cyperaceae): A briefly annotated list. *Sida* 18: 535–554.
- Löve, A. & D. Löve. 1981. Chromosome number reports LXXIII. *Taxon* 30: 829–861.
- Mackenzie, K. K. 1922 [1923]. Notes on *Carex*—XII. *Bull. Torrey Bot. Club* 49: 361–373.
- . 1931. Cariceae. *N. Amer. Fl.* 18: 1–168.
- Mohlenbrock, R. H. 1999. The Illustrated Flora of Illinois. Sedges: *Carex*. Southern Illinois Univ. Press, Carbondale.
- Reznicek, A. A. & P. E. Rothrock. 1997. *Carex molestiformis* (Cyperaceae), a new species of section *Ovales* from the Ozark Mountain region. *Contr. Univ. Michigan Herb.* 21: 299–308.
- Rohlf, F. J. 1997. NTSYS-pc: Numerical Taxonomy and Multivariate Analysis System. Version 2.00. Exeter Software, Setauket, New York.
- Rothrock, P. E. & A. A. Reznicek. 1996a. A new species of *Carex* section *Ovales* occurring in the Ozark Mountain region. *Brittonia* 48: 104–110.
- & ———. 1996b. Chromosome numbers in *Carex* section *Ovales* (Cyperaceae) from eastern North America. *Sida* 17: 251–258.
- & ———. 1998. Chromosome numbers in *Carex* section *Ovales* (Cyperaceae): Additions, variations, and corrections. *Sida* 18: 587–592.
- Shinners, L. H. 1958. Spring Flora of the Dallas–Forth Worth Area, Texas. Published by the author, Dallas.
- Tanaka, N. 1942. Chromosome studies in Cyperaceae. XX. Chromosome numbers of *Carex* (*Vignea*—II). *Med. and Biol.* 2: 220–224.
- Yatskievych, G. 1999. Steyermark's Flora of Missouri, Vol. 1, Revised ed. Missouri Department of Conservation, Jefferson City, and Missouri Botanical Garden Press, St. Louis.